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407445 mt

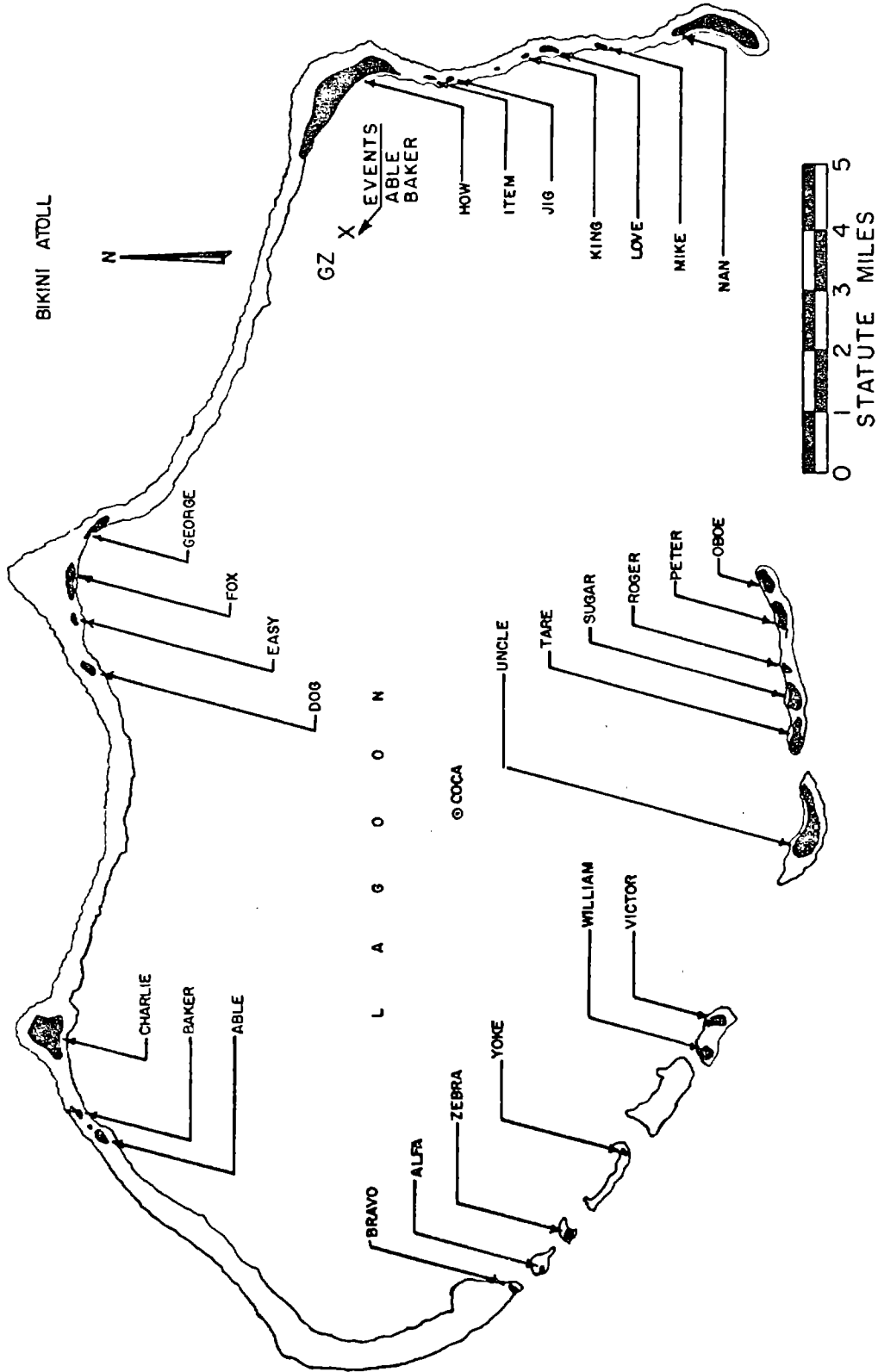


Figure 1 Operations CROSSROADS, Shot Locations.

OPERATION CROSSROADS -

Baker

	<u>PPG time</u>	<u>GMT</u>
<u>DATE:</u>	25 Jul 1946	24 Jul 1946
<u>TIME:</u>	0835	2135

Sponsor: LASL and DOD

SITE: PPG - Bikini - Near How  
11° 37' 10" N  
165° 29' 28" E  
Site elevation: Sea level

TOTAL YIELD: 23 kt

HEIGHT OF BURST: -90 ft

TYPE OF BURST AND PLACEMENT:

Underwater - cable-supported  
90 ft above lagoon floor.  
Lagoon was 180 ft deep.

FIREBALL DATA:

Time to 1st minimum:	NM
Time to 2nd maximum:	NM
Radius at 2nd maximum:	NM

CLOUD TOP HEIGHT: 7,600 ft MSL

CRATER DATA:

Diameter:	3,300 ft maximum
	1,800 ft minimum
Depth:	25 ft

REMARKS:

The contamination pattern is unreliable. The dose-rate readings used for the pattern were obtained from the total dose measured by film badges collected between D+10 days and D+15 days. The radioactivity on the target vessels diminished At its greatest extent the base surge extended about 2,000 yd upwind, 3,000 yd crosswind and 4,000 yd downwind. "The contamination resulted from fallout or radioactive rain from the mushroom head reinforced somewhat by condensation of the base surge. Ideally there should have been an annular infinitive-dose pattern as a result of fallout from the outer edges of the mushroom head. This ideal pattern was changed because of the intermittent behavior of the rain-out and because of the varying ability of the different target ships to retain the fallout activity."

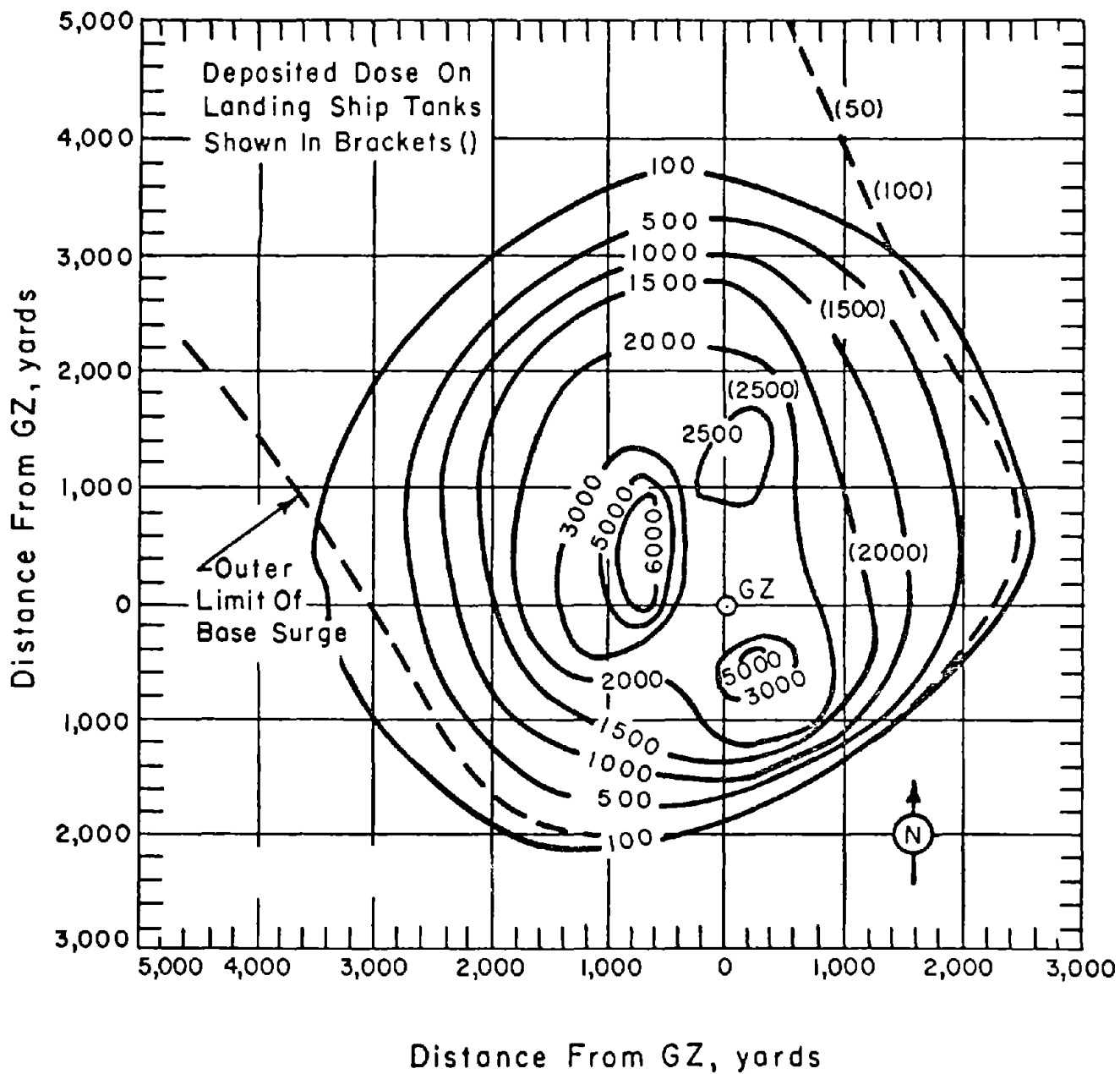


Figure 4. Operation CROSSROADS - Baker. On-site dose rate contours in r/hr at H+1 hour.

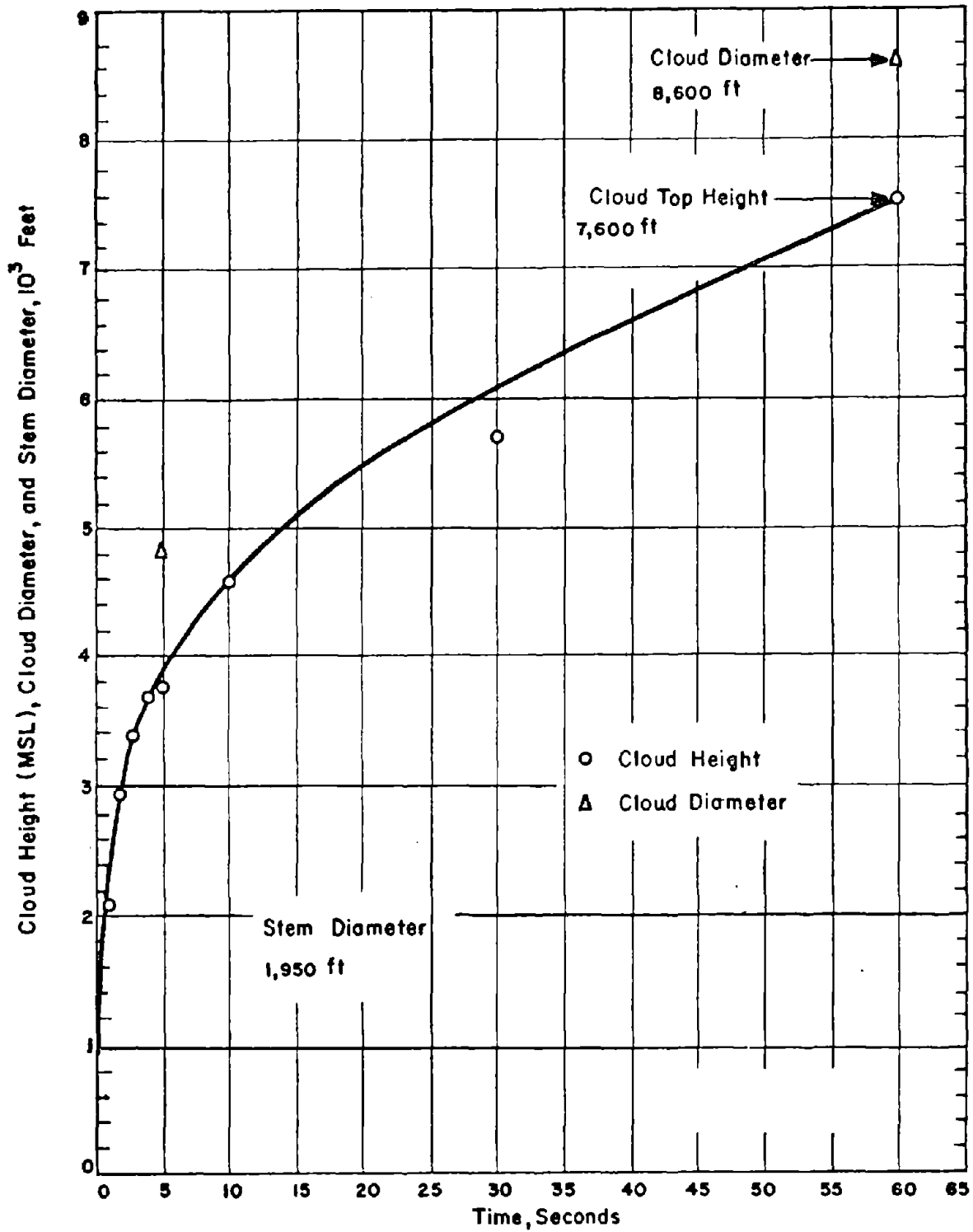


Figure 5. Cloud Dimensions: Operation CROSSROADS - Baker.

TABLE 2 BIKINI WIND DATA FOR OPERATION CROSSROADS - BAKER

Altitude (MSL) feet	H-hour		Altitude (MSL) feet	H-hour	
	Direction degrees	Speed mph		Direction degrees	Speed mph
Surface	200	03	14,000	080	09
2,000	160	12	15,000	080	09
4,000	160	12	16,000	080	13
6,000	150	09	20,000	110	09
8,000	150	08	25,000	050	12
10,000	120	09	30,000	040	20
12,000	110	14	35,000	060	32

NOTES:

1. Surface wind data was obtained at H+1 hour on Bikini; upper wind data was obtained on board the "Fall River."
2. Tropopause height was 54,000 to 60,000 feet (exact height is uncertain).
3. At H-hour the surface air pressure was 14.68 psi, the temperature 28.9°C and the dew point 25.0°C.

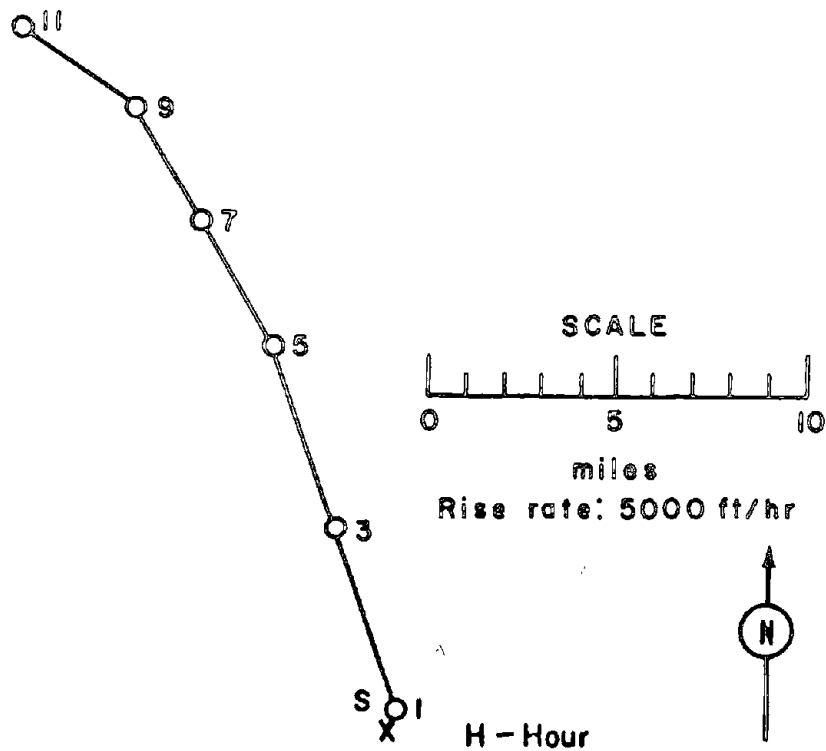


Figure 6. Hodographs for Operation CROSSROADS - Baker

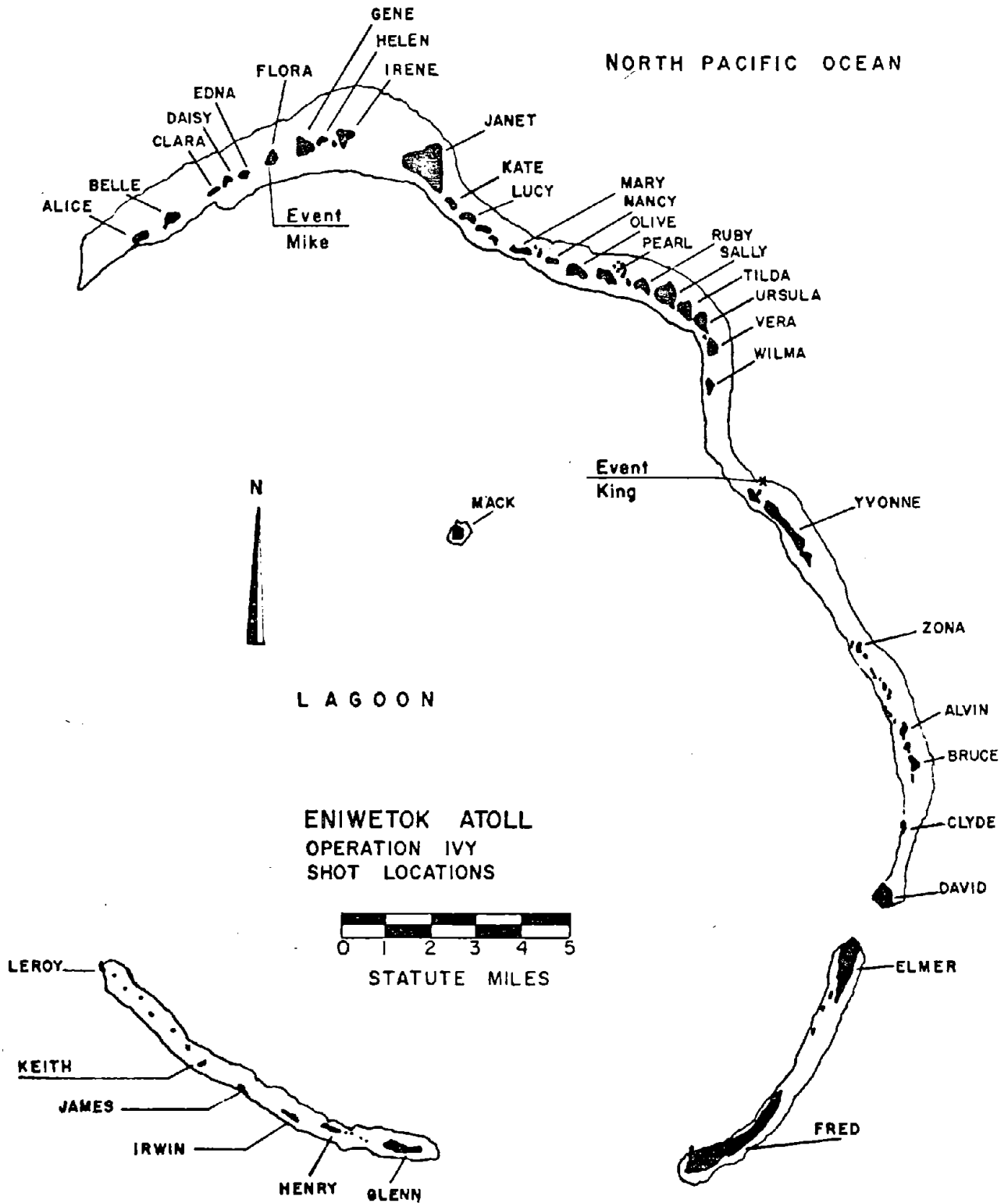


Figure 30. Operation IVY, Shot Locations.

OPERATION IVY - Mike

	<u>PPG time</u>	<u>GMT</u>
<u>DATE:</u>	1 Nov 1952	31 Oct 1952
<u>TIME:</u>	0715	1915

Sponsor: LASL

SITE: PPG - Eniwetok - Flora  
11° 14' 14" N  
162° 11' 41" E  
Site elevation: Sea level

TOTAL YIELD: 10.4 mt

HEIGHT OF BURST: Surface

FIREBALL DATA:

Time to 1st minimum: 270 to 310 msec  
Time to 2nd maximum: 3 to 3.5 sec  
Radius at 2nd maximum: NM

TYPE OF BURST AND PLACEMENT:  
Surface burst on coral soil  
and water

CLOUD TOP HEIGHT: 98,000 ft MSL  
CLOUD BOTTOM HEIGHT: 59,000 ft MSL

CRATER DATA: Diameter: 6,240 ft  
Depth: 164 ft

REMARKS:

Most of the fallout occurred over the open sea. Documentation of the fallout was thus limited to the islands and the lagoon of Eniwetok atoll. The lagoon dose rates were determined by multiplying the readings obtained on rafts by the factor 7. This factor is based upon the ratio of Operation Jangle field dose rates and readings taken over flat plates after their removal from the contaminated area. The data presented for the lagoon stations can thus be considered as approximations only. The island dose rates are based upon ground- and aerial-survey readings and were adjusted to H+1 hour by using the  $t^{-1.2}$  law to approximate the decay.



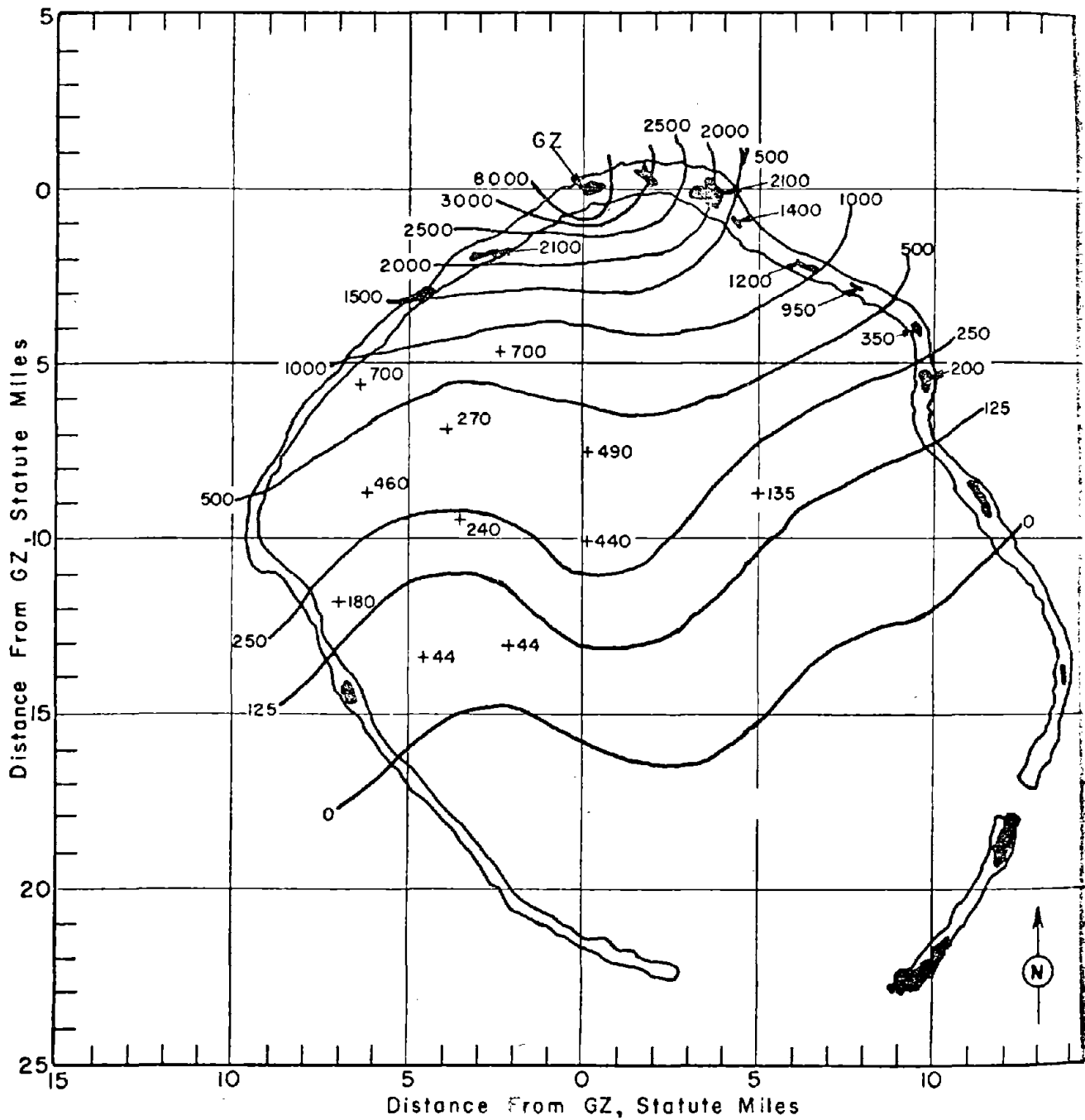


Figure 31 Operation IVY - Mike. Atoll dose rate contours in r/hr at H+1 hour.

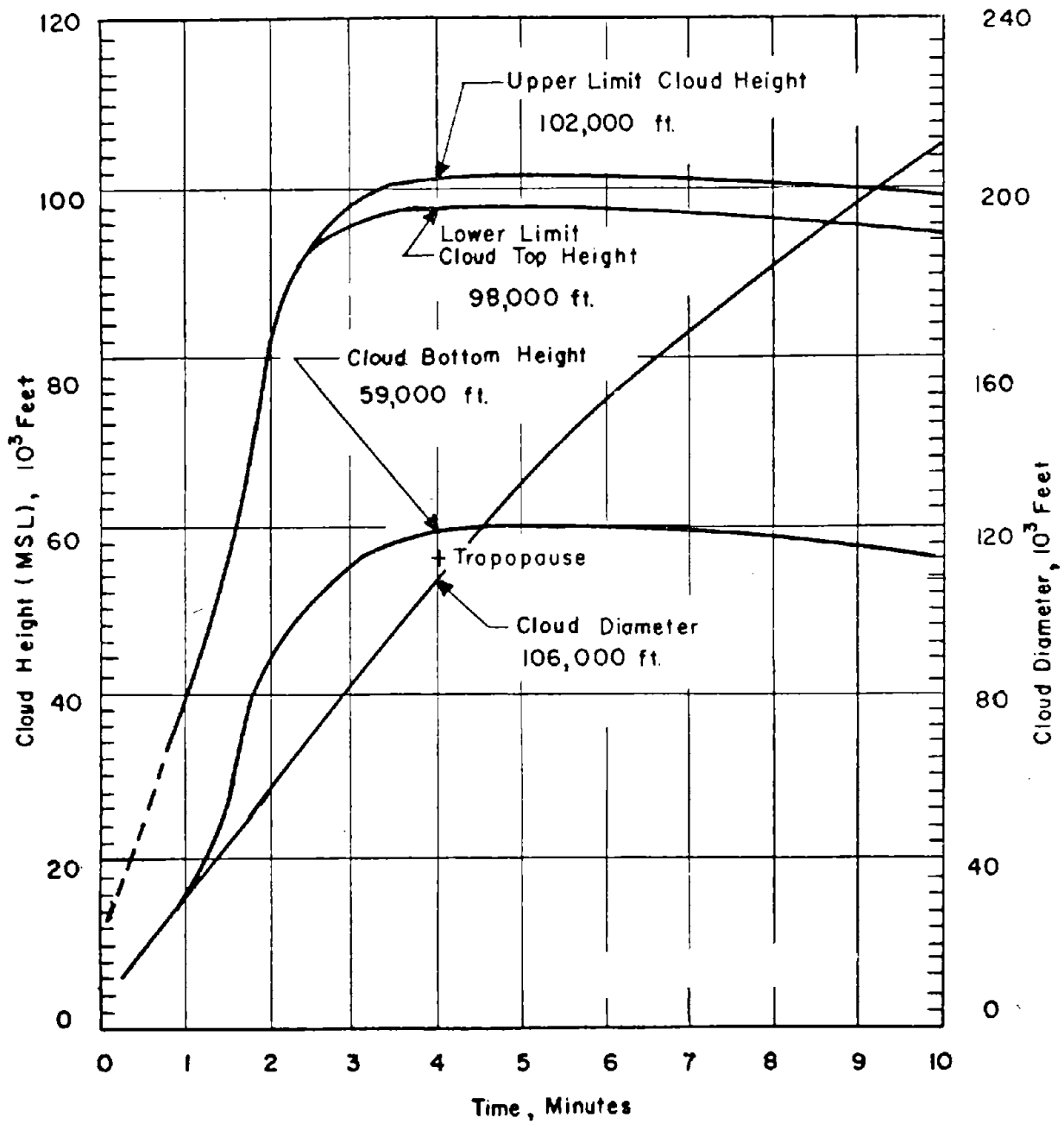


Figure 32 . Cloud Dimensions: Operation IVY - Mike.

TABLE 10 ENIWETOK WIND DATA FOR OPERATION IVY -

MIKE

Altitude (MSL) feet	H-hour	
	Dir degrees	Speed mph
Surface	090	05
5,000	090	16
10,000	095	17
15,000	115	17
20,000	125	14
25,000	170	15
30,000	220	20
40,000	230	17
50,000	220	14
60,000	040	09
70,000	100	23
80,000	085	09
90,000	280	12
100,000	250	23
110,000	300	23
120,000	040	06
130,000	Calm	Calm
135,000	Calm	Calm

## NOTES:

1. Tropopause height was 56,000 ft MSL at H-hour.
2. The surface air pressure was 14.66 psi, the temperature 29.4°C and the dew point 23.8°C.

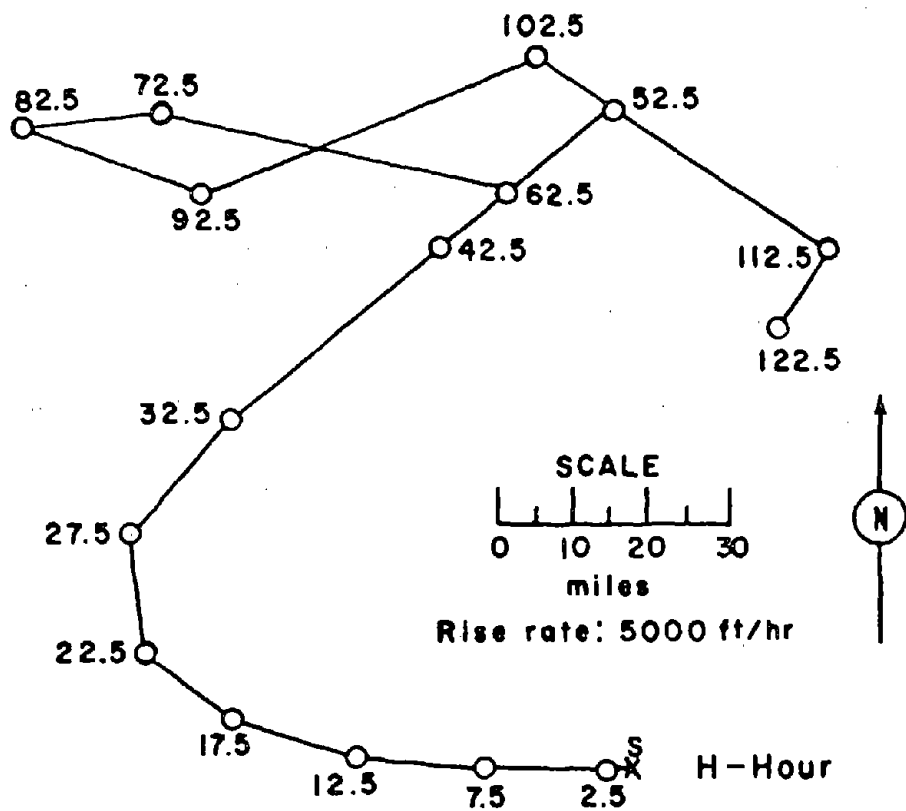
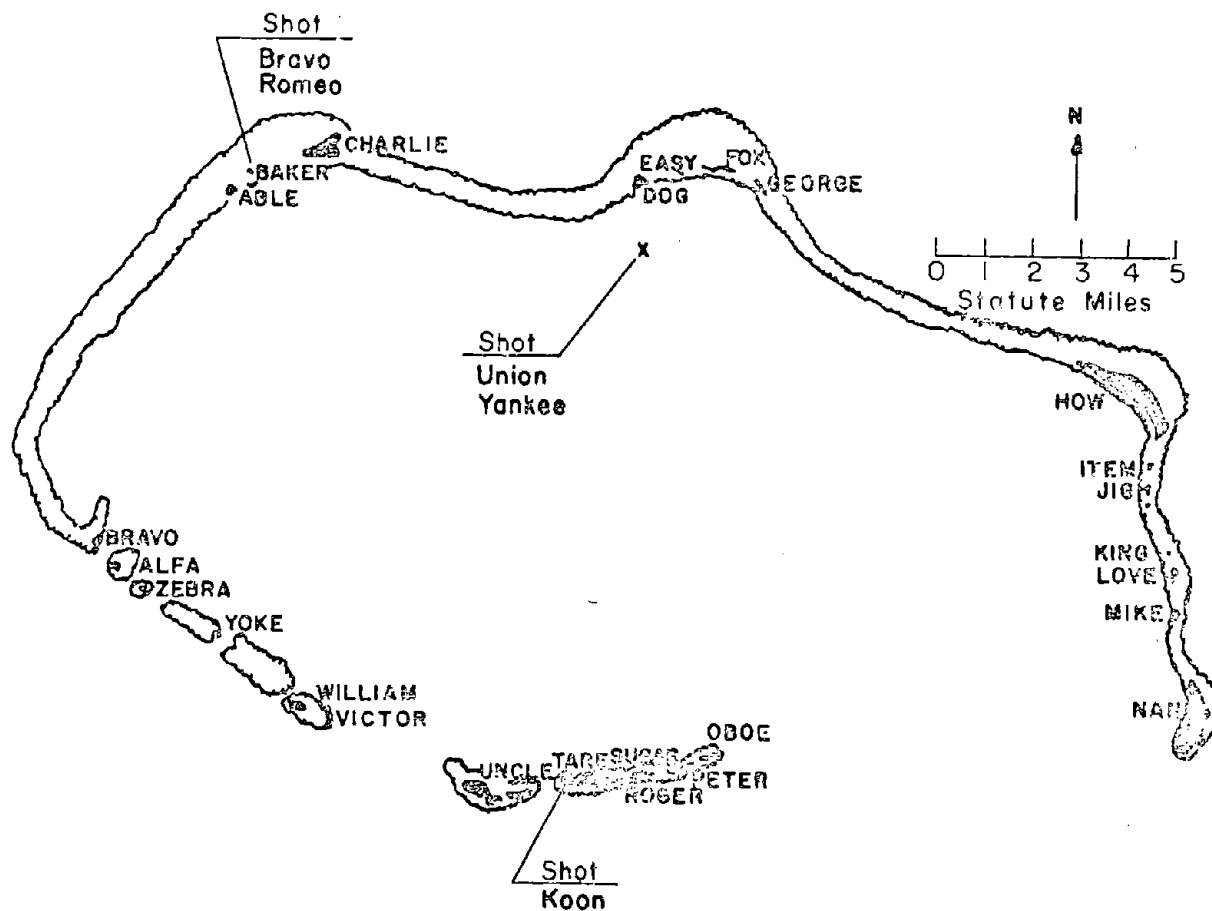


Figure 33 . Hodograph for Operation IVY - Mike.



BIKINI ATOLL  
OPERATION CASTLE  
SHOT LOCATIONS

Figure 37. Operation CASTLE, Shot Locations.

OPERATION CASTLE -

Yankee

	<u>PPG time</u>	<u>GMT</u>
<u>DATE:</u>	5 May 1954	4 May 1954
<u>TIME:</u>	0610	1810

Sponsor: IASL

SITE: PPG - Bikini - near Dog &  
Fox  
11° 39' 56" N  
165° 23' 13" E  
Site elevation: Sea level

TOTAL YIELD: 13.5 Mt

HEIGHT OF BURST: 7 ft

CLOUD TOP HEIGHT: 110,000 ft MSL.  
CLOUD BOTTOM HEIGHT: 61,300 ft MSL

TYPE OF BURST AND PLACEMENT:

Surface burst from barge on water

REMARKS:

The individual island dose rates were computed from the D+1 day aerial-survey readings of the Radiological Safety organization. The various readings were corrected to H+1 hour, using the  $t^{-1.2}$  relationship, and extrapolated to 3 ft above the surface, using the air-to-ground conversion factors determined later for the REDWING Flathead shot 102. The Fox, George, Nan, Oboe, Uncle and William readings were taken at ground level. All other readings were obtained by aerial survey. The off-site fallout pattern was documented for the first time by a combined water-surface reading, aerial survey, and water-sampling operation. The dose-rate readings were extrapolated to H+1 hour by using actual decay rates.

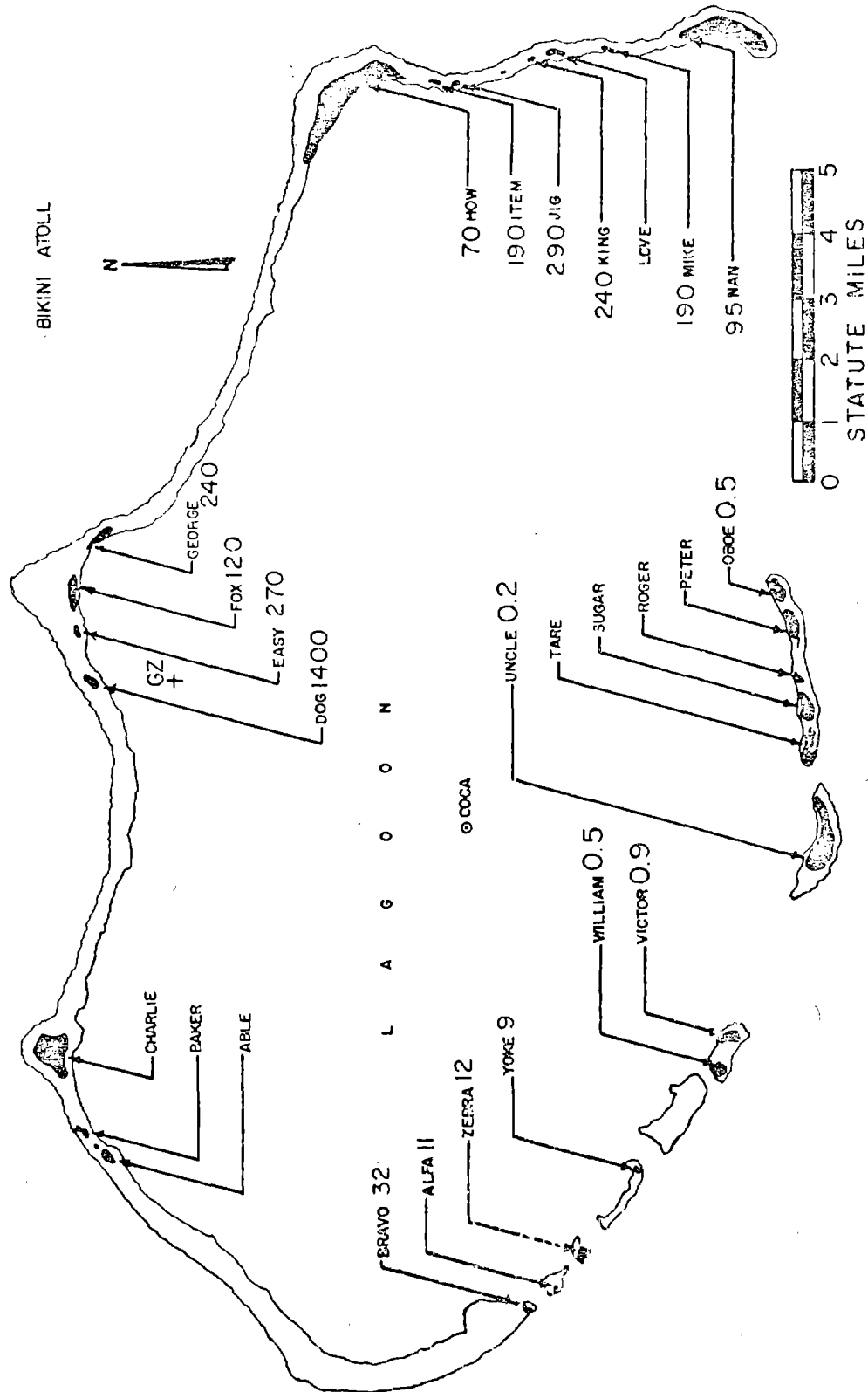


Figure 53. Operation CASTLE - Yankee.  
Island dose rates in r/hr at H+1 hour.

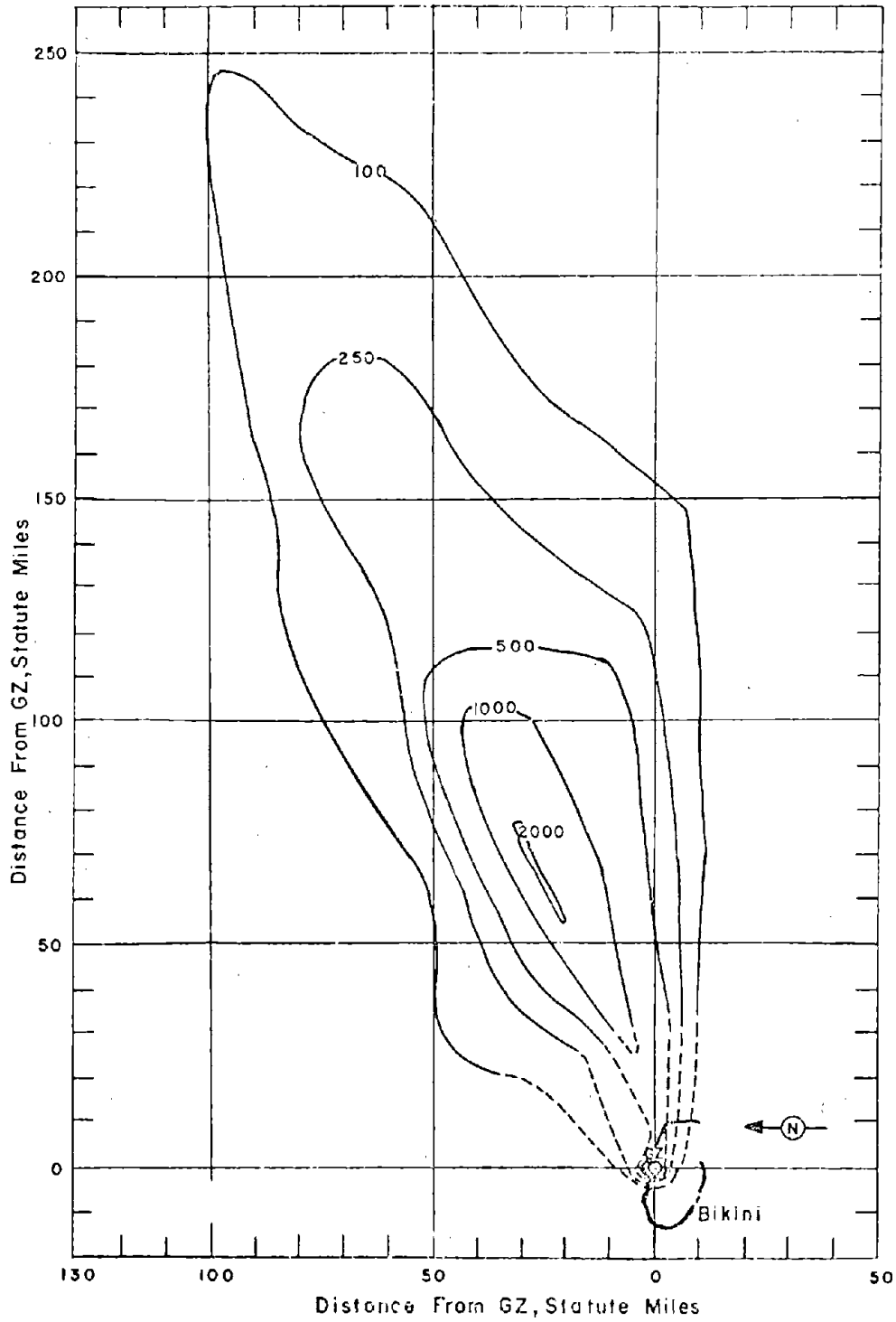


Figure 54. Operation CASTLE - Yankee.  
Off-site dose rate contours in r/hr at H+1 hour.



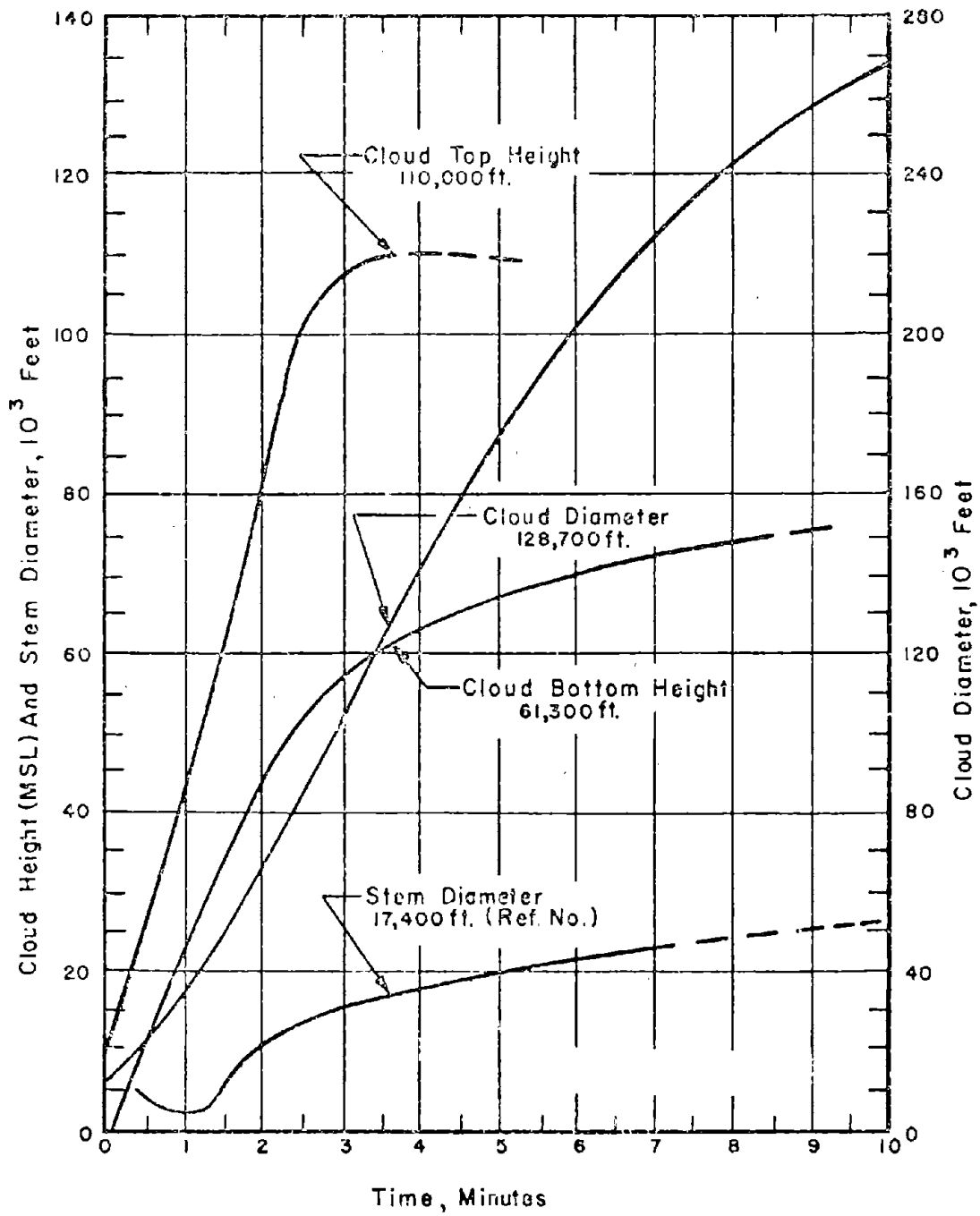


Figure 55. Cloud Dimensions: Operation CASTLE - Yankee.

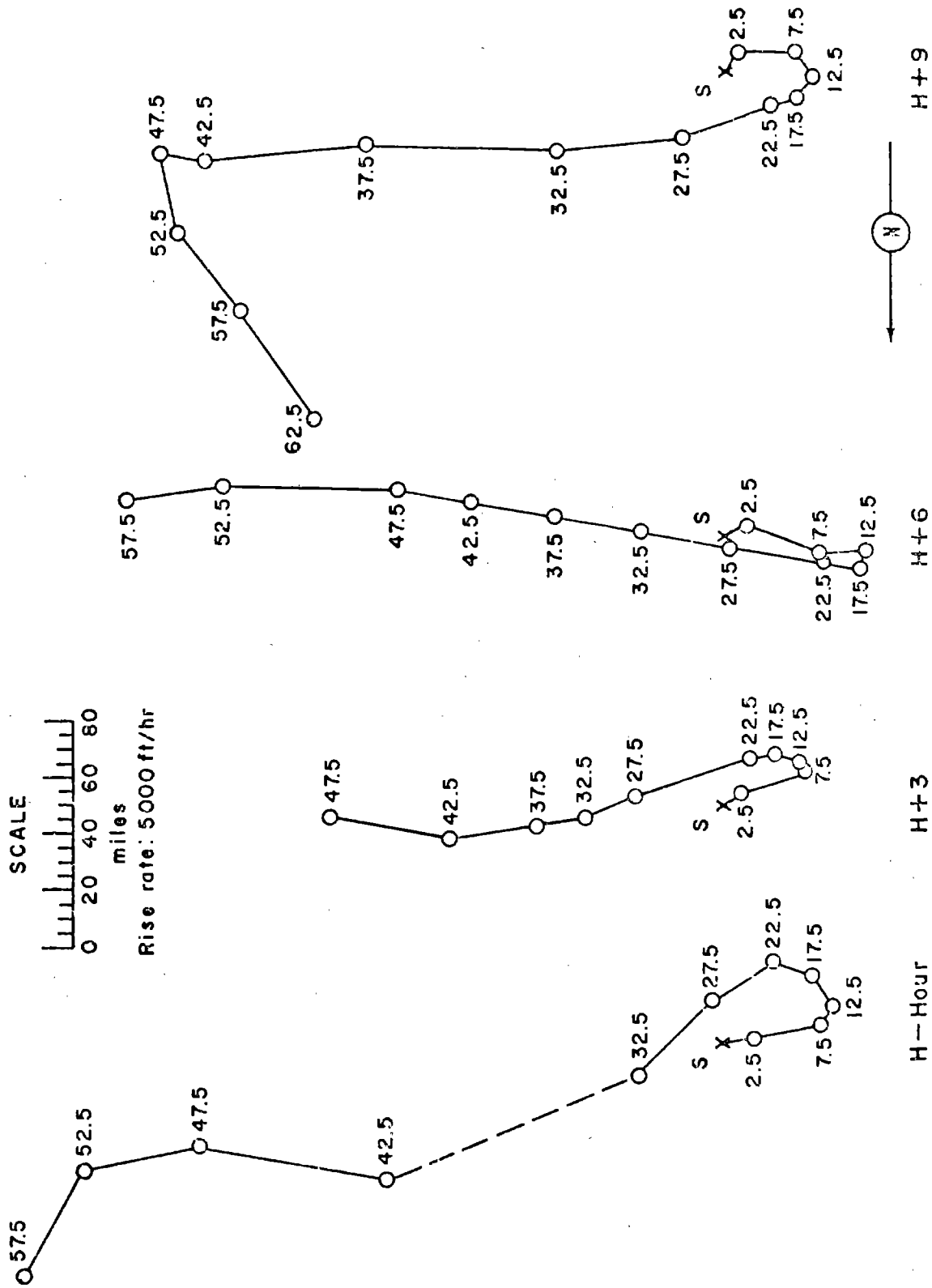
TABLE 16 BIKINI WIND DATA FOR OPERATION CASTLE -

YANKEE

Altitude (MSL) feet	H-hour		H+3 hours		H+6 hours		H+9 hours	
	Dir degrees	Speed mph	Dir degrees	Speed mph	Dir degrees	Speed mph	Dir degrees	Speed mph
Surface	080	28	050	18	060	20	020	15
1,000	070	26	---	--	---	--	---	--
2,000	080	29	070	29	090	26	080	22
3,000	080	28	---	--	---	--	---	--
4,000	080	26	070	25	110	30	090	23
5,000	(080)	(25)	(080)	(24)	(110)	(29)	(090)	(20)
6,000	070	23	090	23	110	29	090	18
7,000	070	21	---	--	---	--	---	--
8,000	070	13	040	13	090	24	110	12
9,000	040	07	---	--	---	--	---	--
10,000	020	06	320	02	080	17	140	10
12,000	010	06	290	02	060	08	180	07
14,000	340	06	350	09	110	03	210	05
15,000	(330)	(10)	(290)	(08)	(200)	(06)	(220)	(06)
16,000	320	15	240	07	290	08	230	06
18,000	280	10	330	13	290	14	240	12
20,000	290	16	260	10	280	12	260	10
25,000	230	26	250	40	280	36	250	32
30,000	220	39	240	18	280	33	260	42
35,000	---	--	260	16	280	31	270	66
40,000	---	--	260	29	280	29	260	57
45,000	280	64	280	46	280	25	280	14
50,000	250	51	---	--	270	62	170	30
55,000	200	53	---	--	260	33	140	37
60,000	---	--	---	--	---	--	140	46

## NOTES:

1. Numbers in parentheses are estimated values.
2. Wind data was obtained on board the U. S. S. Curtiss.
3. Tropopause height was 55,000 ft MSL.
4. At H-hour the sea level pressure was 1018.8 mb, the temperature 80.8°F, the dew point 75.0°F and the relative humidity 84%.



Yarboe.

Figure 56. Hofographs for Operation CASTLE -

OPERATION CASTLE - Nectar

	<u>PPG time</u>	<u>GMT</u>
<u>DATE:</u>	14 May 1954	13 May 1954
<u>TIME:</u>	0620	1820

Sponsor: IASL

SITE: PPG - Eniwetok -  
Ivy Mike Crater  
11° 40' 14" N  
162° 11' 47" E  
Site elevation: Sea level

TOTAL YIELD: 1.69 Mt

HEIGHT OF BURST: 7 ft

CLOUD TOP HEIGHT: 71,000 ft MSI,  
CLOUD BOTTOM HEIGHT: 40,500 ft MSL

TYPE OF BURST AND PLACEMENT:

Surface burst from barge on water

REMARKS:

The on-site fallout pattern was drawn from Radiological Safety organization data and by converting the readings obtained from fallout samples to equivalent dose-rate readings over land. Since the fallout went in a northerly direction from ground zero very few of the collecting stations received significant fallout. The fallout collected was primarily upwind fallout. Aerial survey was used for measurements north of the atoll, and two tugs gathered water samples throughout the fallout area. Analyses of the water samples, combined with an estimate of the depth of mixing, served to determine the land-equivalent exposure rate at a number of points. The aerial survey served to fill in the contours.

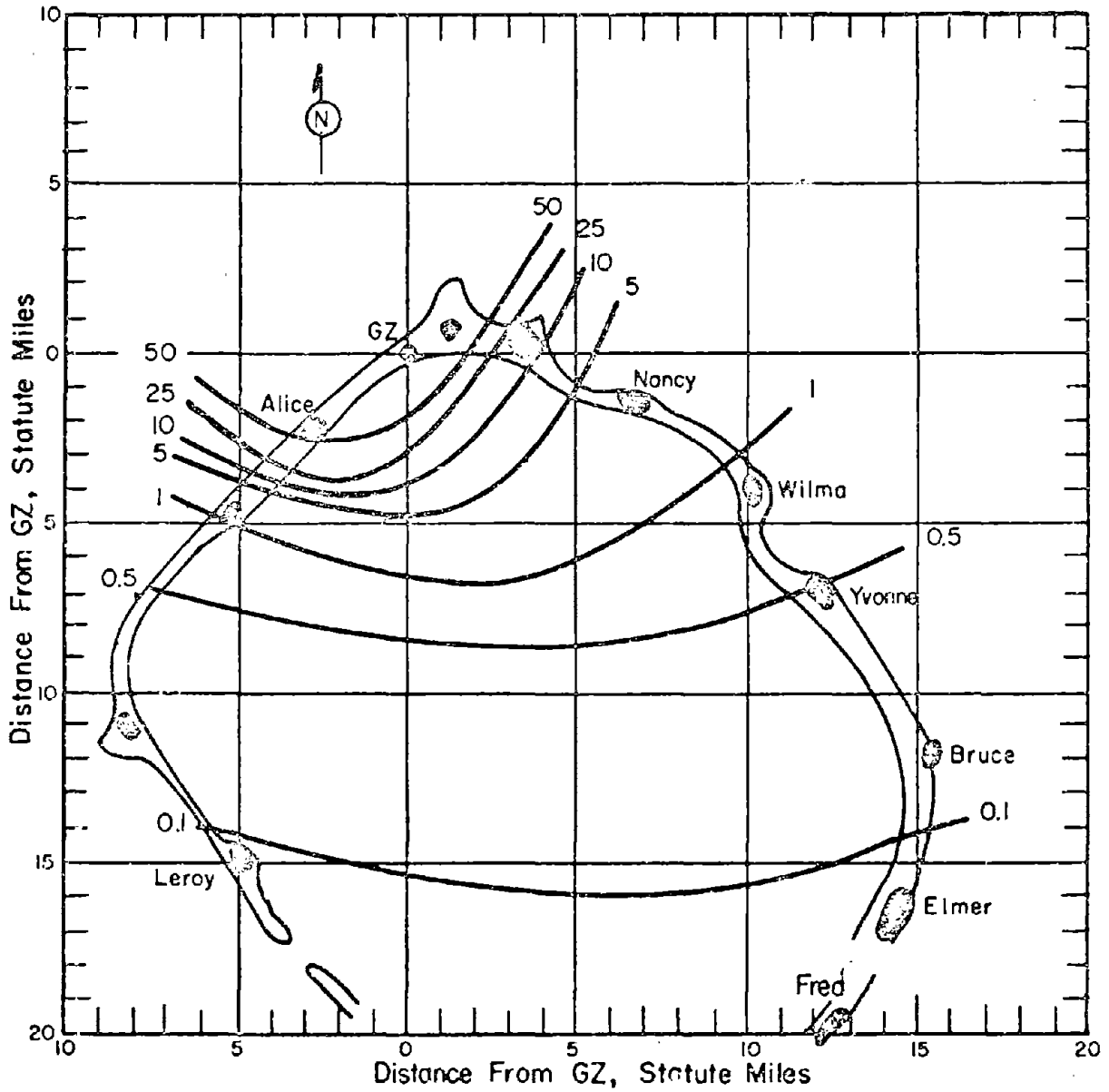


Figure 57. Operation CASTLE - Nectar.  
On-site dose rate contours in r/hr at H+1 hour.

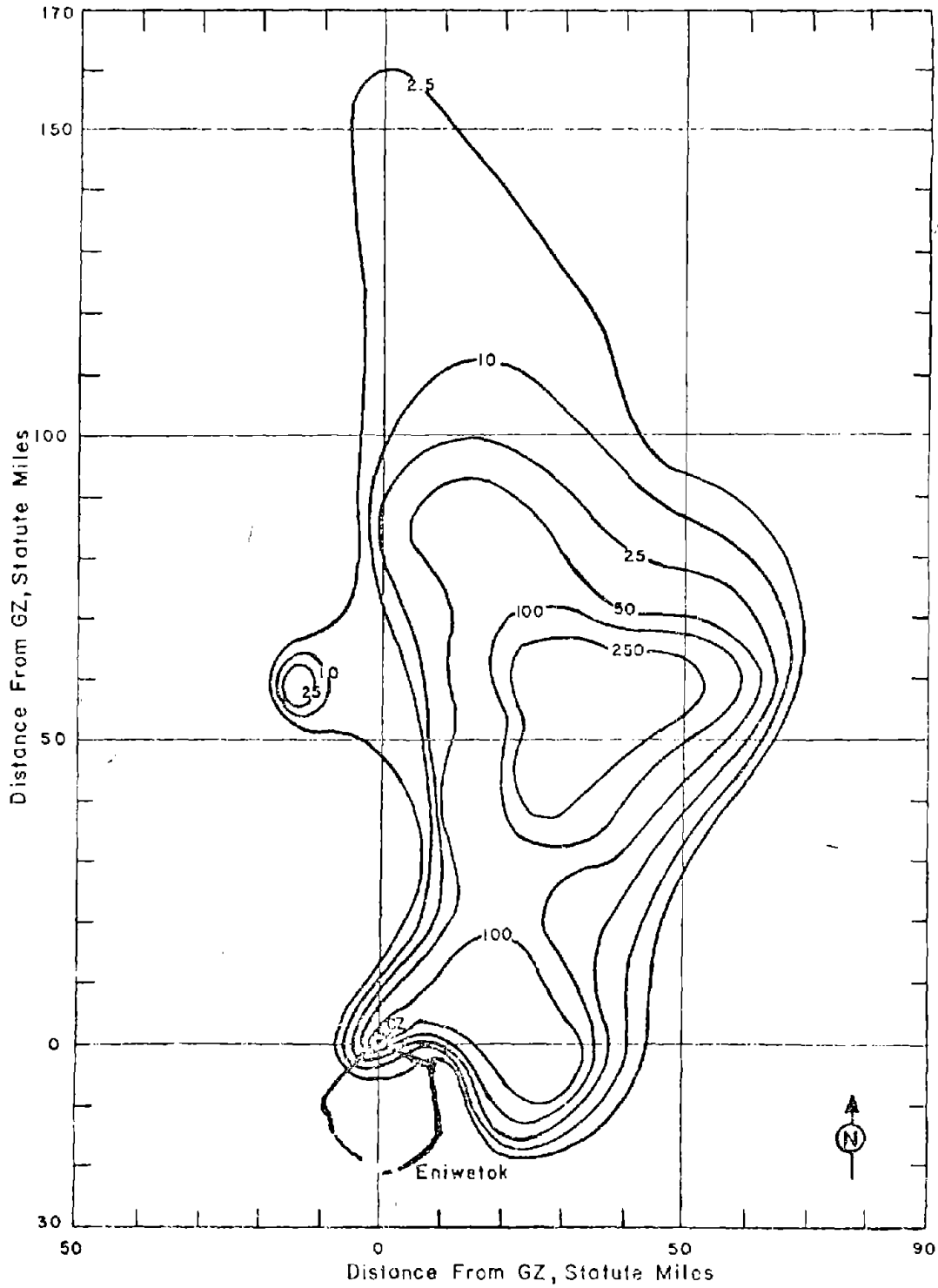


Figure 58. Operation CASTLE - Nectar.  
Off-site dose rate contours in r/hr at H+1 hour.

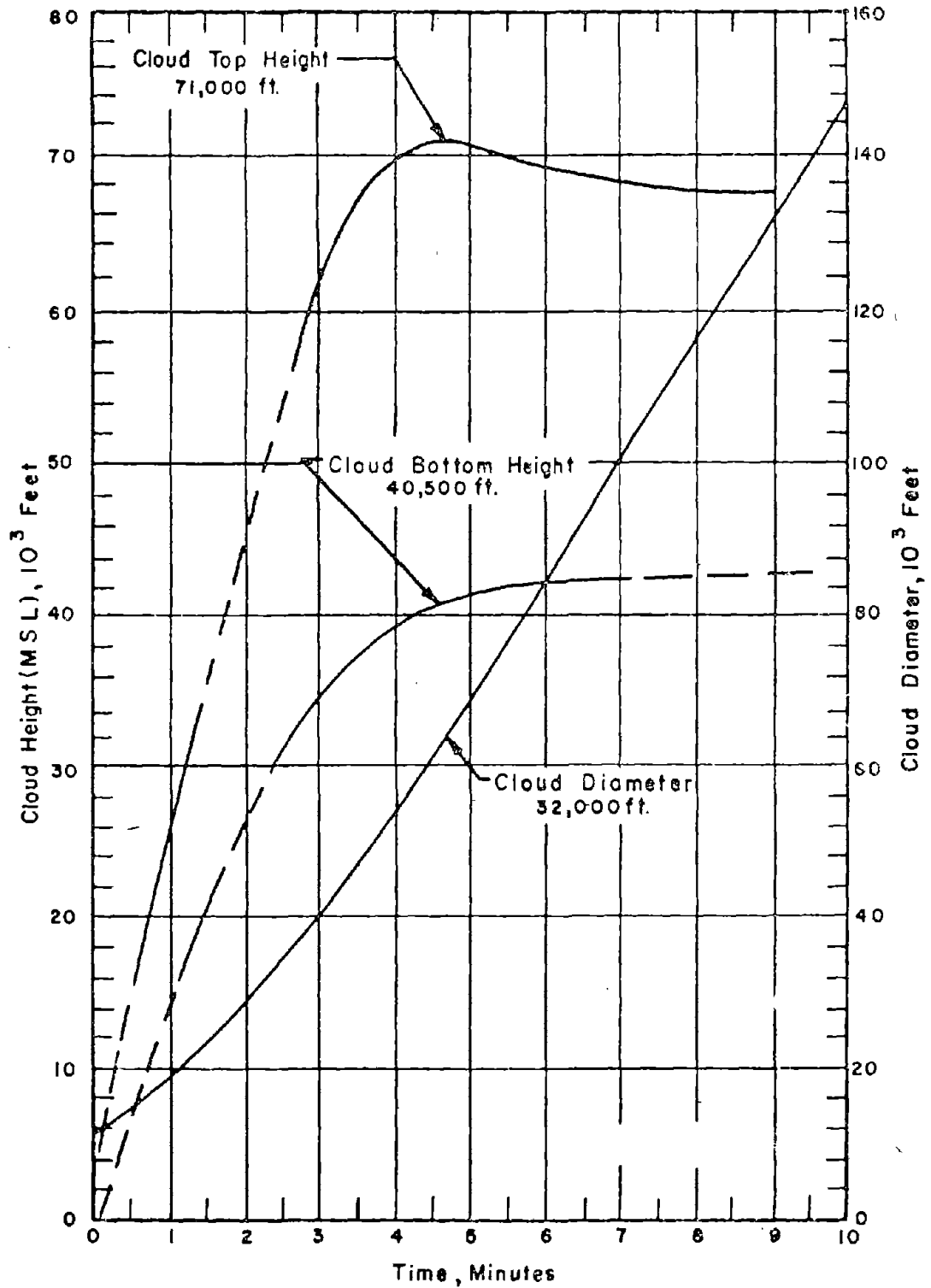


Figure 59 . Cloud Dimensions: Operation CASTLE - Nectar.

TABLE 17 ENIWETOK WIND DATA FOR OPERATION CASTLE -

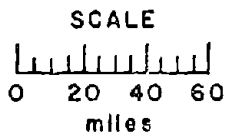
NECTAR

Altitude (MSL) feet	H-hour		H+3 hours		H+9 hours	
	Dir degrees	Speed mph	Dir degrees	Speed mph	Dir degrees	Speed mph
Surface	090	22	070	23	090	23
1,000	090	24	---	--	---	--
2,000	100	20	110	24	100	20
3,000	110	22	---	--	---	--
4,000	110	22	110	20	140	16
5,000	(110)	(18)	(100)	(16)	(150)	(16)
6,000	110	16	100	14	160	17
7,000	100	14	---	--	---	--
8,000	100	12	120	13	160	16
9,000	110	13	---	--	---	--
10,000	110	16	130	16	170	16
12,000	120	20	140	12	190	20
14,000	110	21	120	16	200	21
15,000	(120)	(17)	(120)	(18)	(200)	(18)
16,000	130	14	120	18	200	17
18,000	140	14	200	08	190	17
20,000	130	09	150	21	190	15
25,000	190	07	210	06	Calm	Calm
30,000	230	19	200	14	Calm	Calm
35,000	210	10	210	29	180	16
40,000	210	29	210	31	180	10
45,000	230	37	240	24	Calm	Calm
50,000	280	40	280	27	Calm	Calm
55,000	290	44	310	30	230	14
60,000	---	--	---	--	240	18

## NOTES:

1. Numbers in parentheses are estimated values.
2. Wind data was obtained by the weather station on Eniwetok Island.
3. Tropopause height was 56,000 ft MSL.
4. At H-hour the sea level pressure was 1006.4 mb, the temperature 80°F, the dew point 75°F and the relative humidity 85%.





Rise rate: 5000 ft/hr

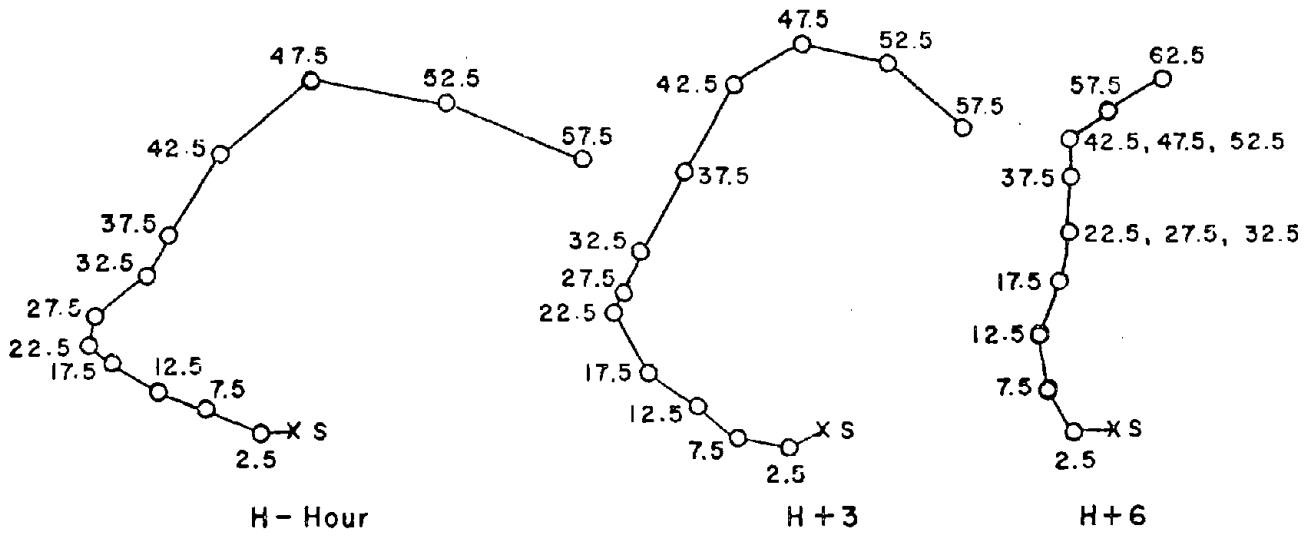


Figure 60. Hodographs for Operation CASTLE - Nectar.

OPERATION WIGWAM

DATE: PDT GMT  
14 May 1955 14 May 1955  
TIME: 1300 2000

Sponsor: DOD

SITE: Pacific Ocean 400 miles  
Southwest of San Diego  
28° 44' N  
126° 16' W

TOTAL YIELD: 30 kt

Site elevation: Sea level

FIREBALL DATA:

Time to 1st minimum: NM  
Time to 2nd maximum: NM  
Radius at 2nd maximum: NM

HEIGHT OF BURST: 2000 ft under-  
water depth 16,000 ft

TYPE OF BURST AND PLACEMENT:

Subsurface burst - Device  
suspended by cable from barge

SPRAY DOME HEIGHT: 880 ft MSL

FIRST PLUME HEIGHT: 1,450 ft MSL

REMARKS:

"The contours given (for H+1.4 hour) were computed on the basis of surface and subsurface water samples and are reproduced here uncorrected. They do not represent fallout activity deposited on the surface. The activity was mixed throughout a surface zone whose depth remained roughly constant for the first two days. This contaminated zone resulted from debris thrown out locally during the surface events or from upwelling of contaminated water from below. The downwind airborne radioactivity varied with the base surge and yielded very little if any residual fallout." At H+19 minutes the contaminated water area was about 5.3 mi<sup>2</sup>. The area was contaminated in an irregular manner, the peak intensities being approximately three times the average intensity of 25 to 30 r/hr, 3 ft above the surface. The area circumscribed by a 50 mr/hr isointensity contour increased to 7.5 mi<sup>2</sup> at H+1.4 hr. At H+4.2 hr it had decreased to 3.5 mi<sup>2</sup>. Measurements of water samples indicated a radioactive decay exponent

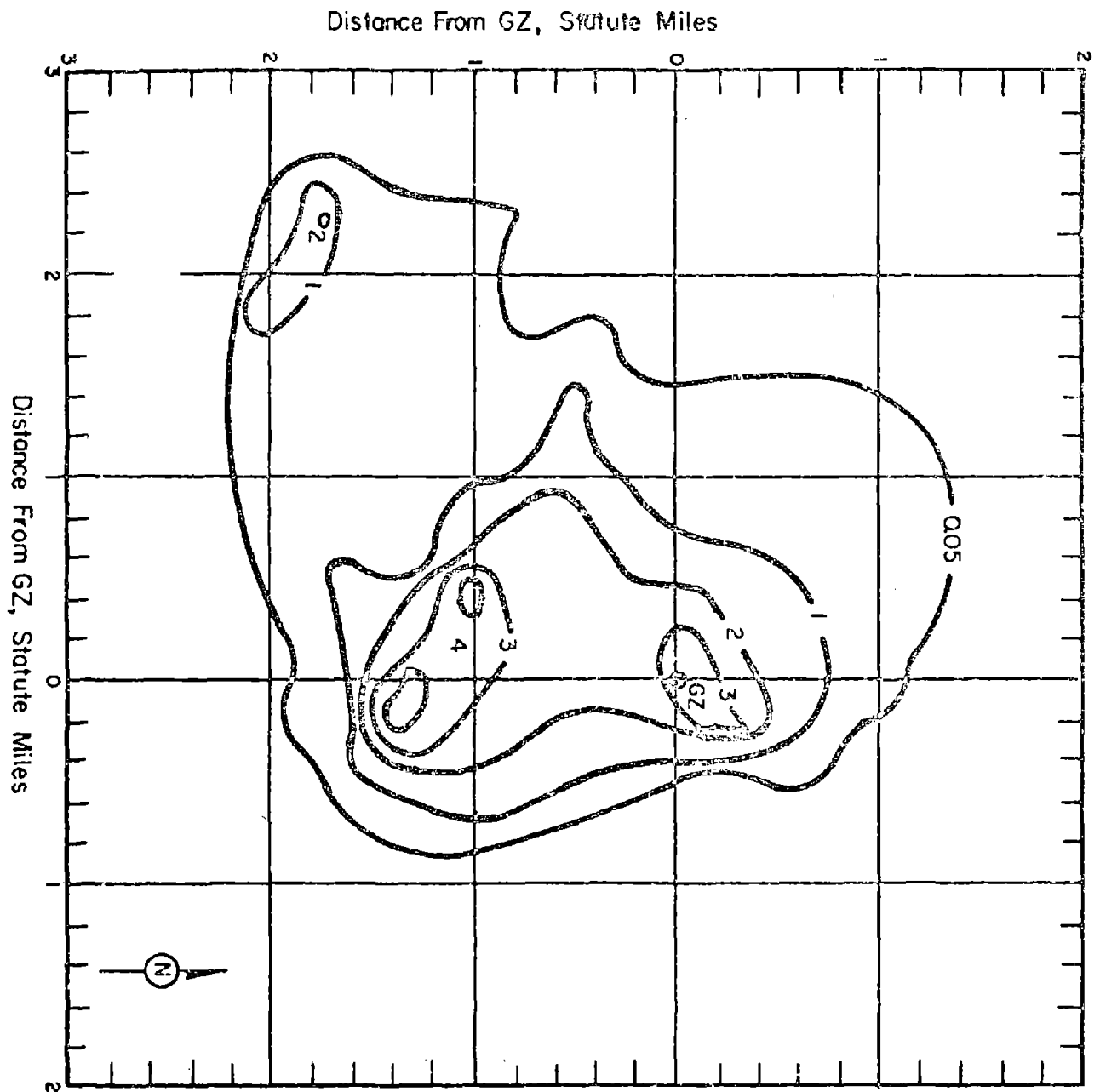


Figure 61. Operation WIGWAM. Off-site dose rate contours in r/hr at H+1.4 hours.

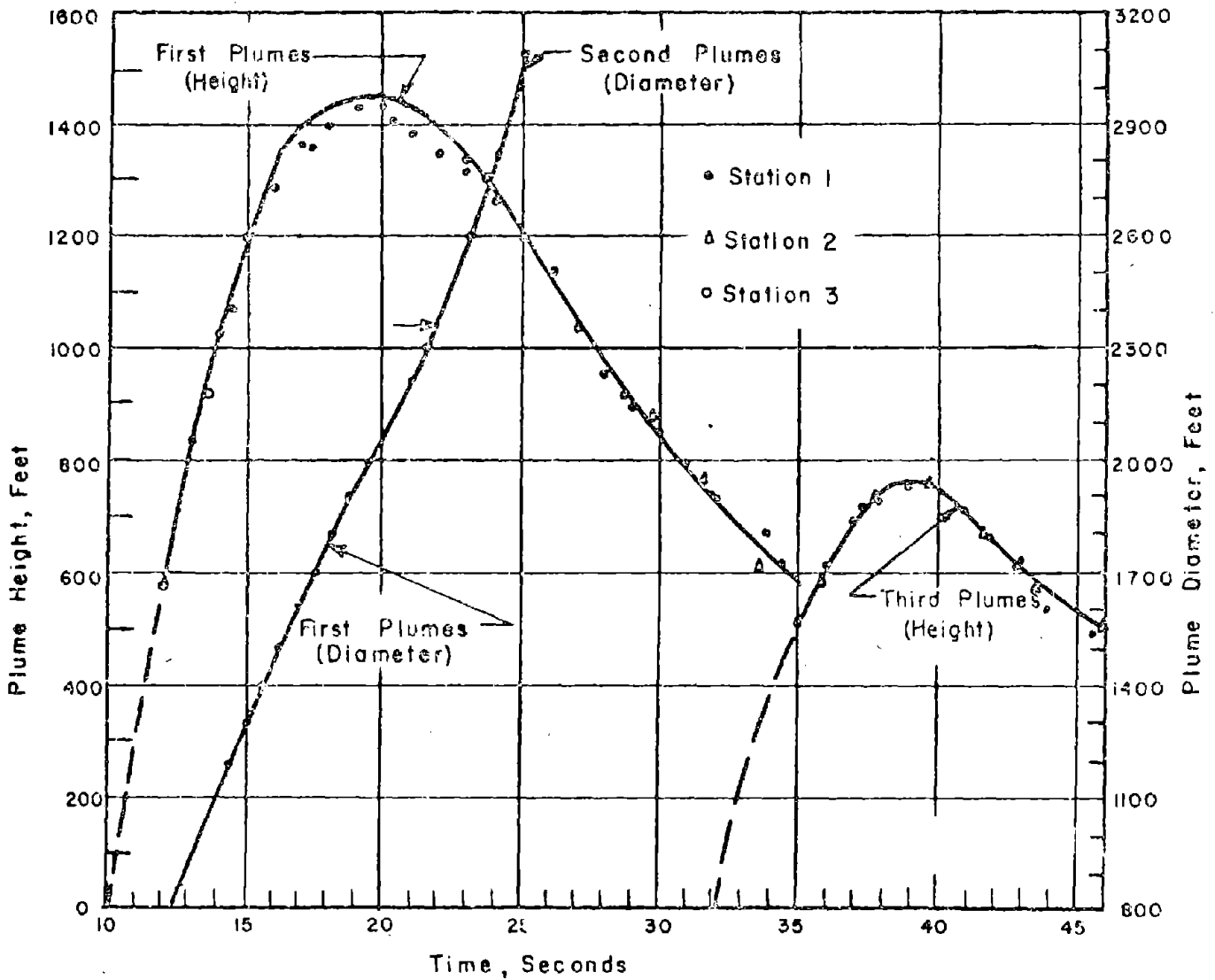


Figure 62. Plume Height Dimensions: Operation WIGWAM.

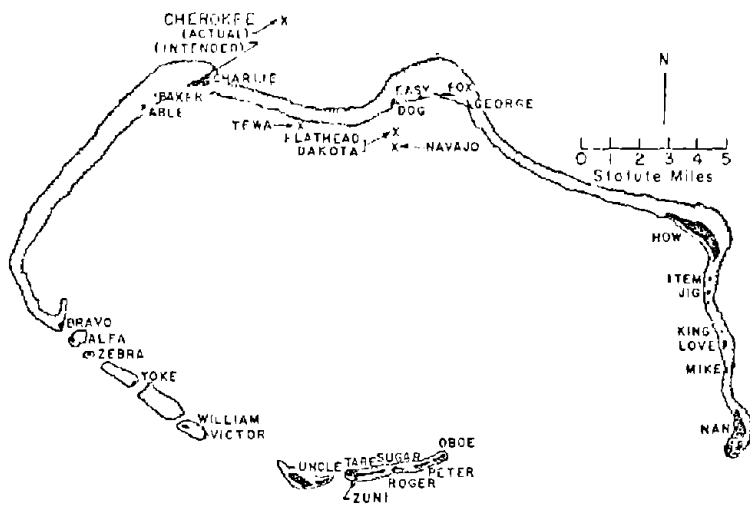


Figure 63. Operation REDWING, Shot Locations, Eniwetok Atoll.

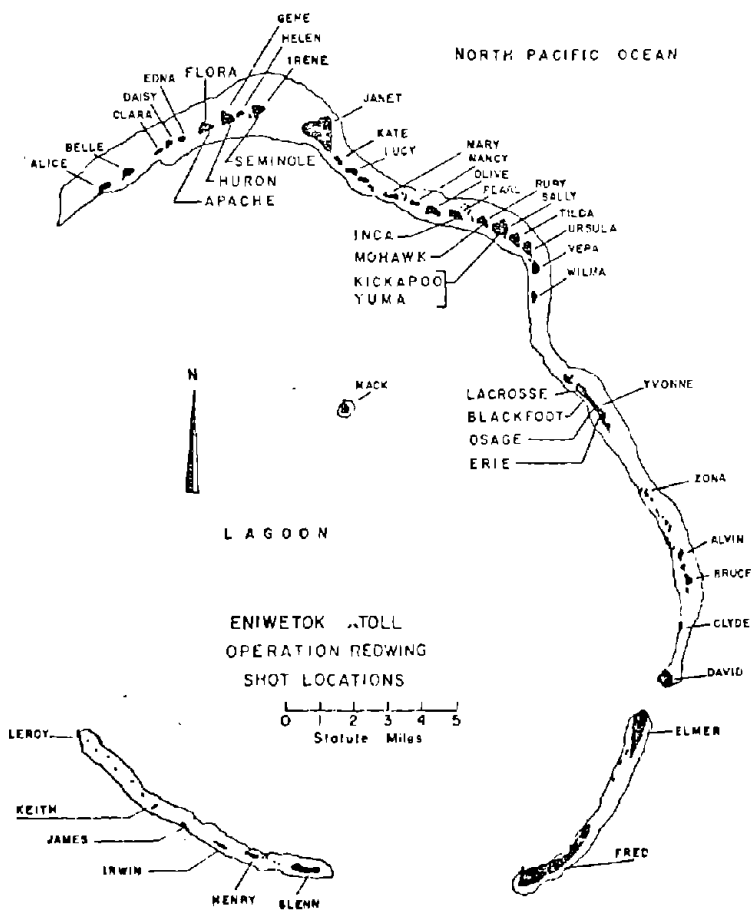


Figure 64. Operation REDWING, Shot Locations, Bikini Atoll.

OPERATION REDWING - LaCrosse

	<u>PPG Time</u>	<u>GMT</u>
<u>DATE:</u>	5 May 1956	4 May 1956
<u>TIME:</u>	0625	1825

Sponsor: LASL

SITE: PPG - Eniwetok - Yvonne  
11° 33' 28" N  
162° 21' 18" E

Site elevation: Sea Level

TOTAL YIELD: 40 kt

HEIGHT OF BURST: 17 ft

FIREBALL DATA:

Time to 1st minimum: 18 to 34 msec  
Time to 2nd maximum: 190 to 254 msec  
Radius at 2nd maximum: 872.5 ft

TYPE OF BURST AND PLACEMENT:

Surface burst from platform on coral soil

CRATER DATA:

Diameter: 404 ft  
Depth: 44 ft  
Lip: 15 ft

CLOUD TOP HEIGHT:

38,000 ft MSL (Ref 105)  
40,000 ft MSL (Ref 112)

CLOUD BOTTOM HEIGHT:

22,000 ft MSL (Ref 105)  
13,000 ft MSL (Ref 112)

REMARKS:

The dose-rates shown for the islands of the atoll are based upon ground and aerial surveys made by the Radiological Safety organization and by Project 2.65. The dose-rate readings in the immediate environment of the crater were calculated from survey readings at low tide on D+1 day and D+2 days, after the reef around the crater had been flushed by at least two high tides. The measured field gamma decay exponent

was used to extrapolate the readings to H+1 hour. The one reading which gave an H+1 hour dose rate of 57,000 r/hr was uniquely high and may have been due to one of the extremely radioactive, partially fused, pieces of metal scattered about near the crater.

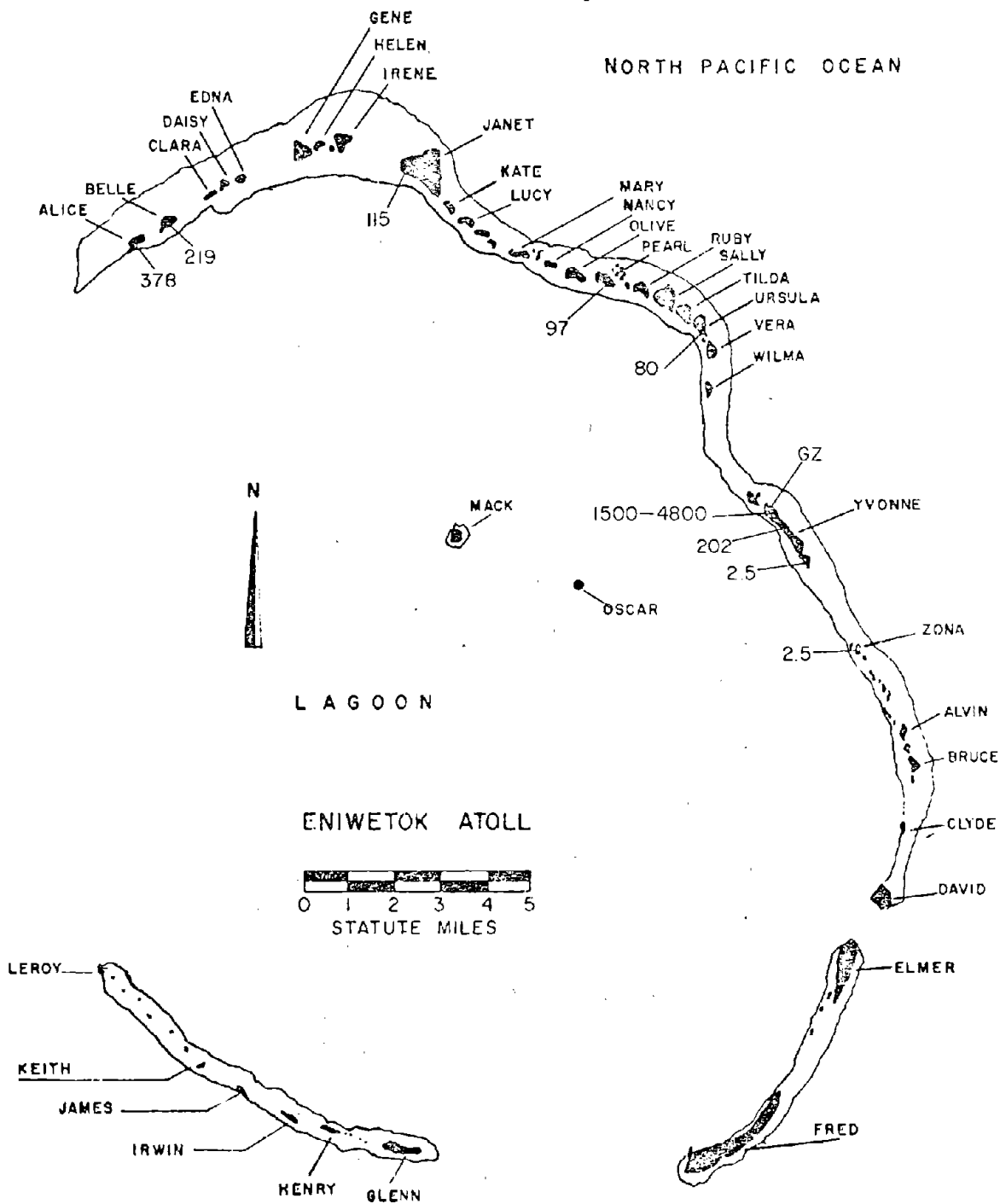


Figure 65. Operation REDWING - Lacrosse. Island dose rates in r/hr at H+1 hour.

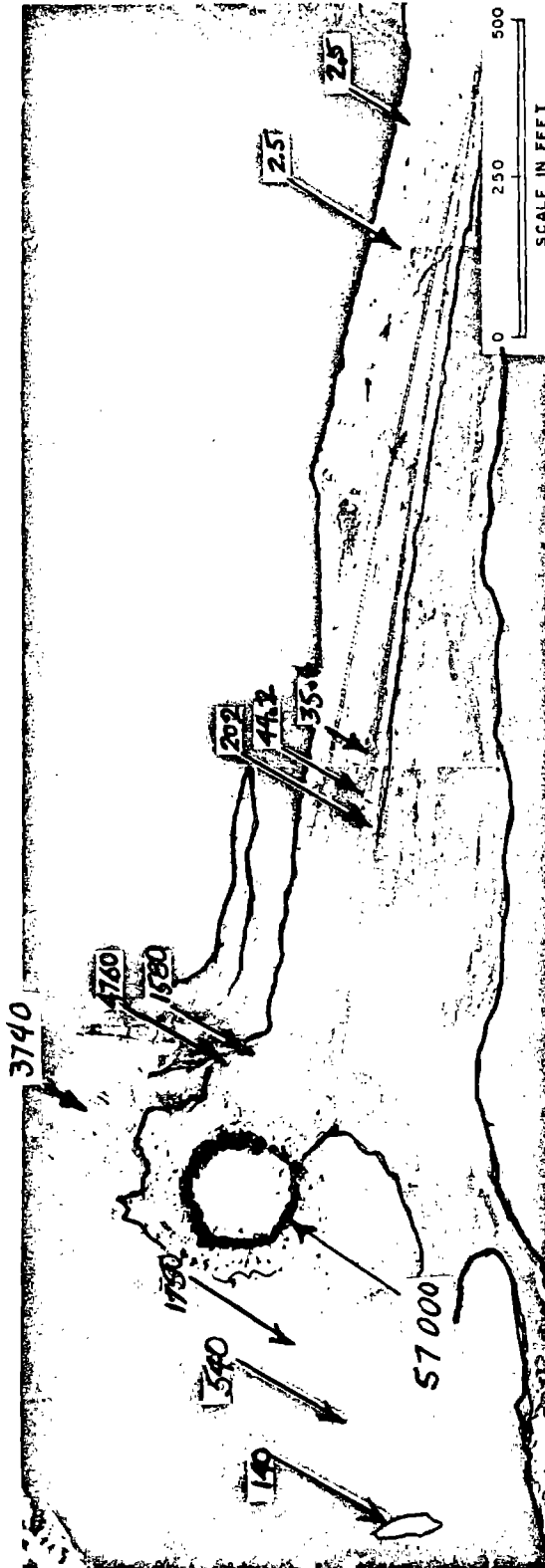


Figure 66. Dose rate readings near the Lacrosse crater in r/hr at H+1 hour.



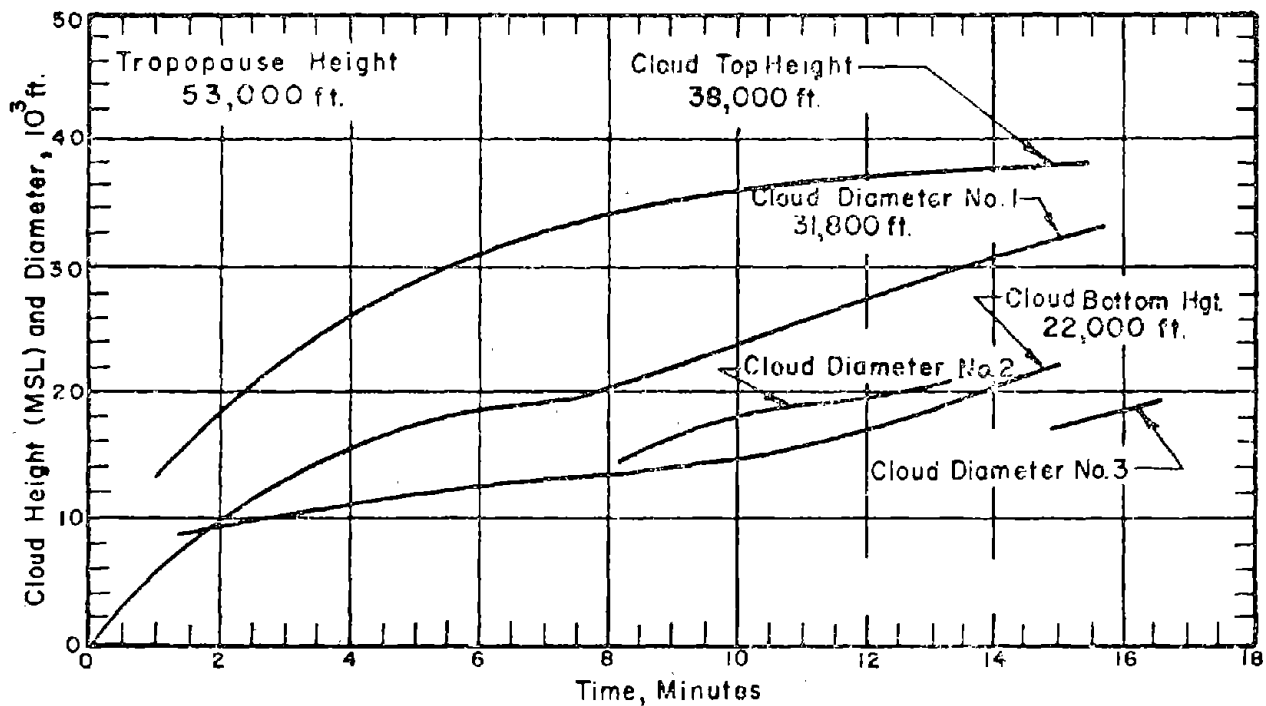


Figure 67. Cloud Dimensions: Operation REDWING - Lacrosse. Diameter-curve 1 represents the diameter of the main cloud; curve 2 refers to a portion of the cloud which resulted from a shear at 8 minutes; curve 3 represents the average diameter of two clouds which resulted from a shear of the second cloud at 15 minutes.

TABLE 18 ENIWETOK WIND DATA FOR OPERATION REDWING-

LACROSSE

Altitude (MSL) feet	H-hour		H+2 $\frac{1}{2}$ hours		H+5 $\frac{1}{2}$ hours		H+8 $\frac{1}{2}$ hours	
	Dir degrees	Speed mph	Dir degrees	Speed mph	Dir degrees	Speed mph	Dir degrees	Speed mph
Surface	070	17	090	15	090	14	090	14
1,000	100	28	090	23	090	18	080	18
2,000	210	28	110	24	090	24	090	22
3,000	110	28	110	26	110	29	100	29
4,000	110	29	110	26	110	31	100	31
5,000	110	33	110	29	110	29	100	32
6,000	100	34	110	28	110	33	110	30
7,000	100	32	110	28	110	33	110	26
8,000	090	26	110	31	110	31	110	23
9,000	090	23	100	33	110	31	120	23
10,000	100	23	100	33	110	26	120	22
12,000	100	13	100	22	100	17	120	20
14,000	110	06	090	07	050	02	120	09
15,000	(180)	(06)	(020)	(07)	(020)	(02)	(040)	(08)
16,000	250	05	320	07	350	03	320	07
18,000	230	05	260	07	270	05	250	05
20,000	240	15	250	17	270	17	210	09
25,000	260	28	260	31	260	30	260	32
30,000	240	43	250	47	240	51	250	47
35,000	260	60	260	55	260	60	260	69
40,000	260	69	250	71	260	68	260	73
45,000	240	58	250	74	260	71	260	75
50,000	240	70	240	71	250	69	240	64
55,000	280	33	250	44	270	32	290	36
60,000	130	09	150	08	180	06	190	13
65,000	130	15	210	05	170	07	140	07
70,000	080	12	090	06	090	13	080	12
75,000	110	32	090	25	110	38	090	37
80,000	090	48	110	47	110	51	100	49
85,000	100	64	090	64	090	62	090	56
90,000	100	72	110	69	100	71	100	61
94,000	100	65	---	--	---	--	---	--
95,000	---	--	100	64	100	57	100	62
98,000	---	--	---	--	---	--	100	63
100,000	---	--	100	65	100	63	---	--
102,000	---	--	---	--	100	63	---	--
105,000	---	--	100	67	---	--	---	--
106,000	---	--	100	67	---	--	---	--

## NOTES:

1. Numbers in parentheses are estimated values.
2. Tropopause height was 52,300 ft MSL. (Reference 149).
3. Wind data was obtained by the weather station on Eniwetok Island.
4. At the surface the air pressure was 14.62 psi, the temperature 27.2°C, the dew point 25.0°C, and the relative humidity 84%.

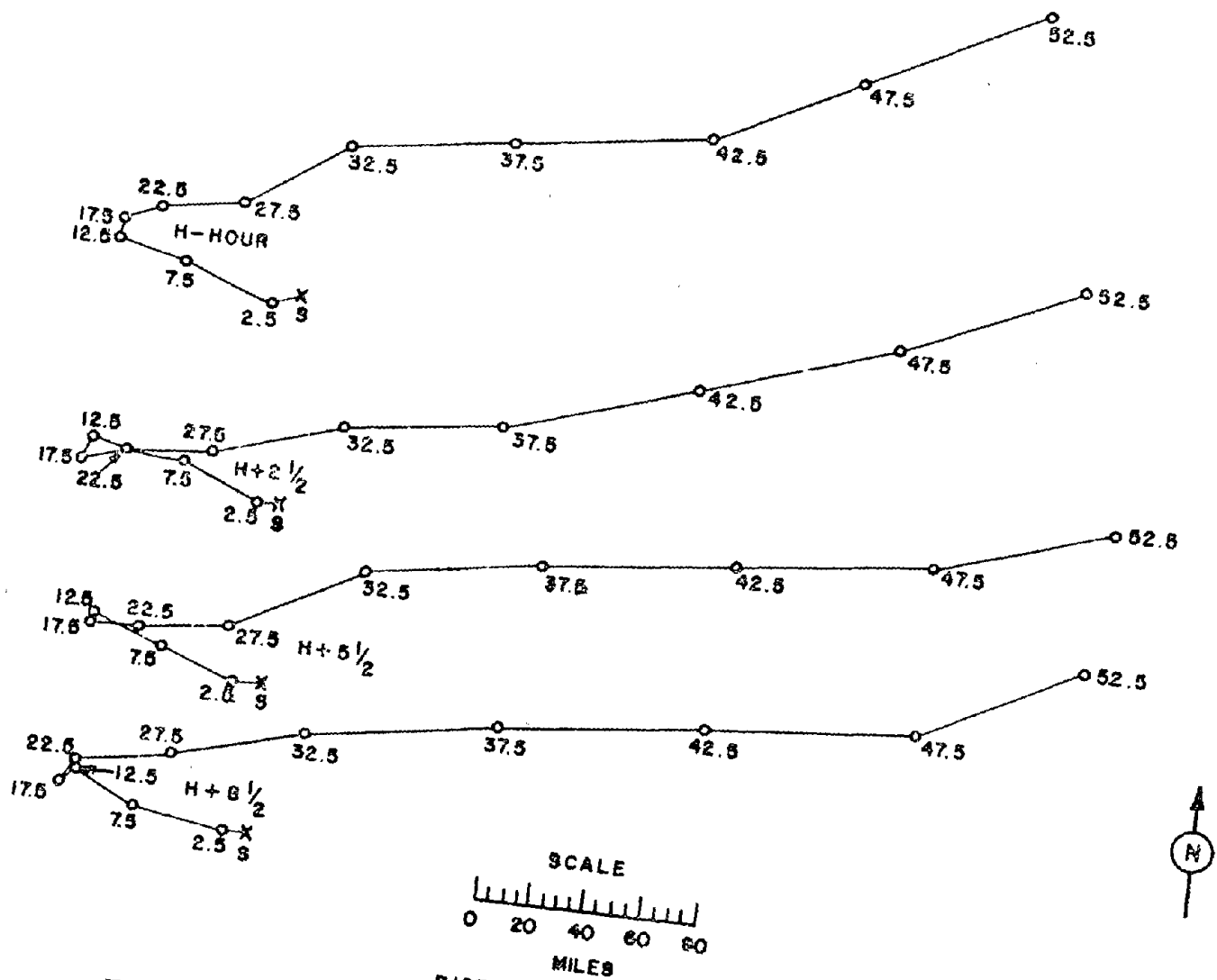


Figure 68. Hodographs for Operation REDWING -

Lacrosse.

OPERATION REDWING -

Tewa

Sponsor: UCRL

DATE: 21 Jul 1956 20 Jul 1956

TIME: 0546 1746

SITE: PPG - Bikini - Charlie -  
Dog Reef

11° 40' 26" N

165° 20' 22" E

Site elevation: Sea level

TOTAL YIELD: 5 Mt

FIREBALL DATA:

Time to 1st minimum: 185 to 240 msec

Time to 2nd maximum: 2.08 sec

Radius at 2nd maximum: 5,904 ft

HEIGHT OF BURST: 15 ft

TYPE OF BURST AND PLACEMENT:

Surface burst from barge on  
water; center of gravity 15  
ft above surface of water;  
depth to bottom 25 ft.

CRATER DATA:

Diameter: 4,000 ft

Depth: 129 ft

CLOUD TOP HEIGHT: 99,000 ft MSL

CLOUD BOTTOM HEIGHT: NM

REMARKS:

The on-site fallout pattern was drawn from island readings taken by scientific projects, supplemented by fallout sample collection on rafts and barges in the lagoon. Actual field decay measurements indicated a decay exponent. This decay exponent was used to extrapolate the dose rate readings to H+1 hour. The extremely heavy rains which followed this shot had no observable effect on the decay rates. On all islands the contamination remaining from previous shots was negligible in comparison with the high radiation levels produced by this shot. Very slight fallout occurring approximately 18 hours after firing increased the background on Nan by approximately 4 mr/hr. In contrast to the other barge shots, contamination was also experienced on the atoll's southwestern islands.

The off-site fallout pattern was drawn from oceanographic surveys. The oceanographic surveys used detector probes for measuring the dose rate at depths to and below the thermocline. Water-sampling equipment was used for the taking of surface samples and for the collection of samples from any desired depth. The dose rate readings were extrapolated to H+1 hour by using the decay measurements of the samples collected. Fallout from the firing of this device contaminated Eniwetok atoll. The fallout on Eniwetok commenced approximately 9 hours after the device was fired with a peak of 100 to 120 mr/hr.

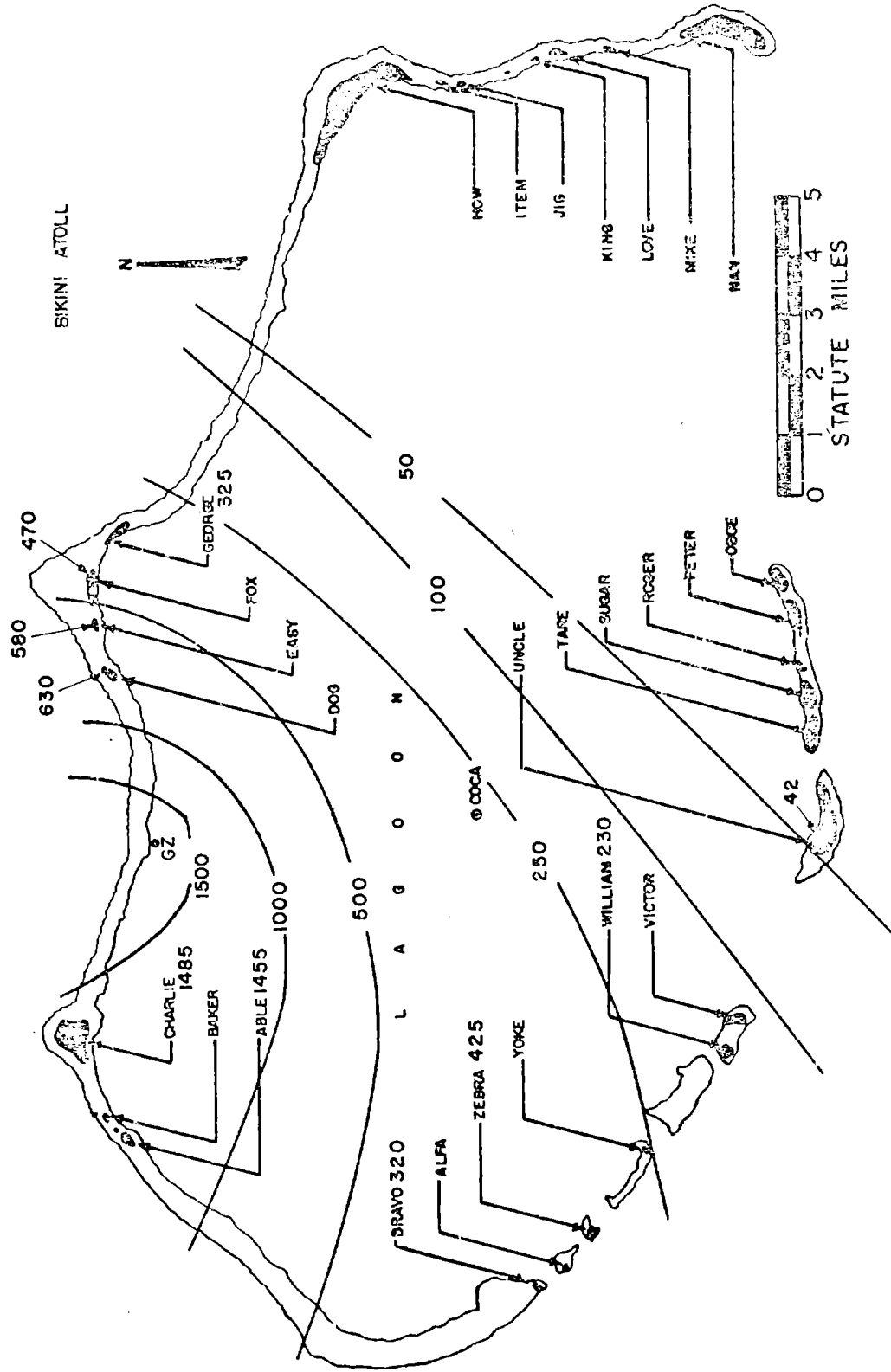


Figure 107 . Operation REDWING - Teva. Atoll dose rate contours in r/hr at H+1 hour.

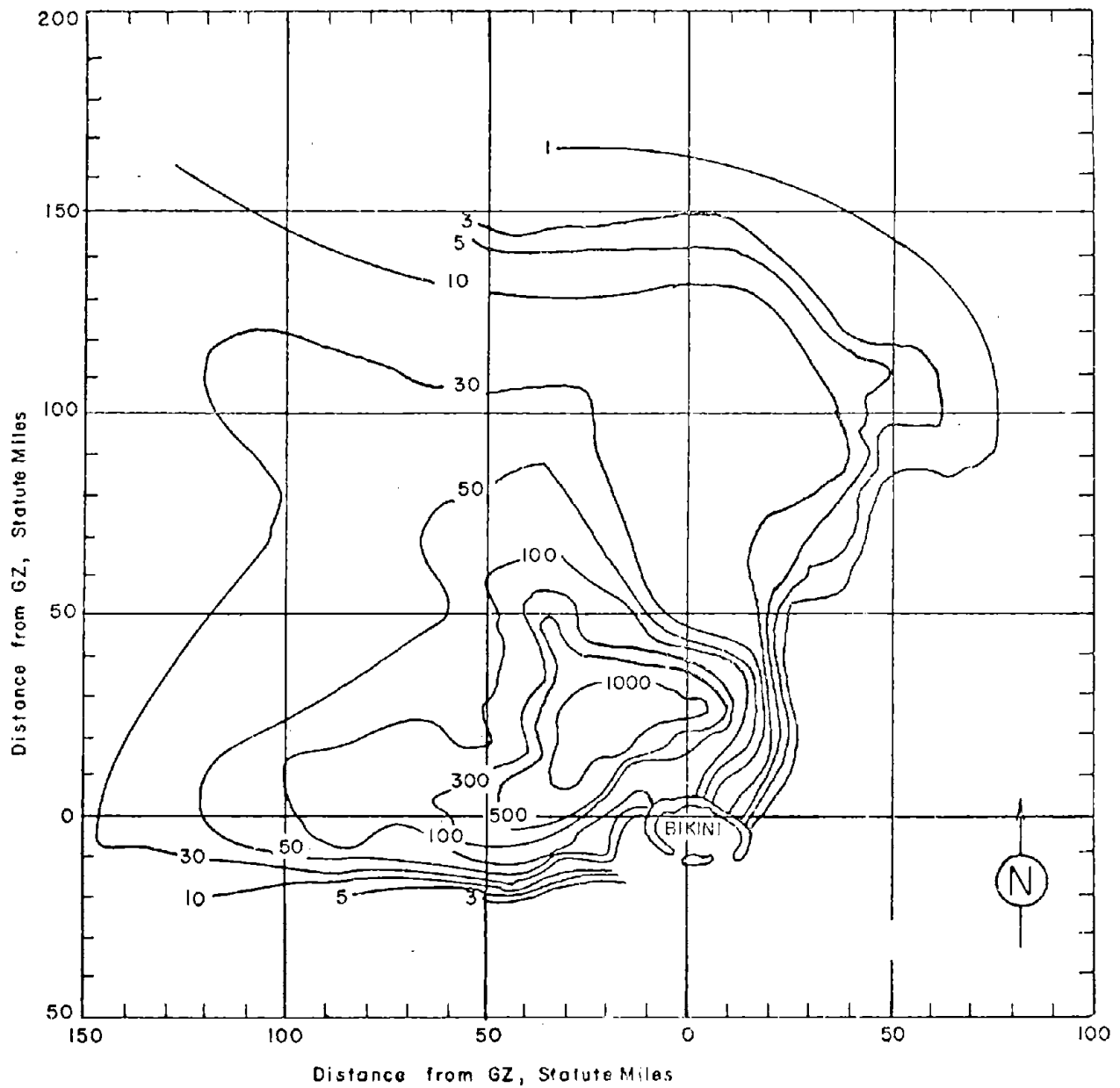


Figure 108. Operation REDWING - Tewa.  
Off-site dose rate contours in r/hr at H+1 hour.

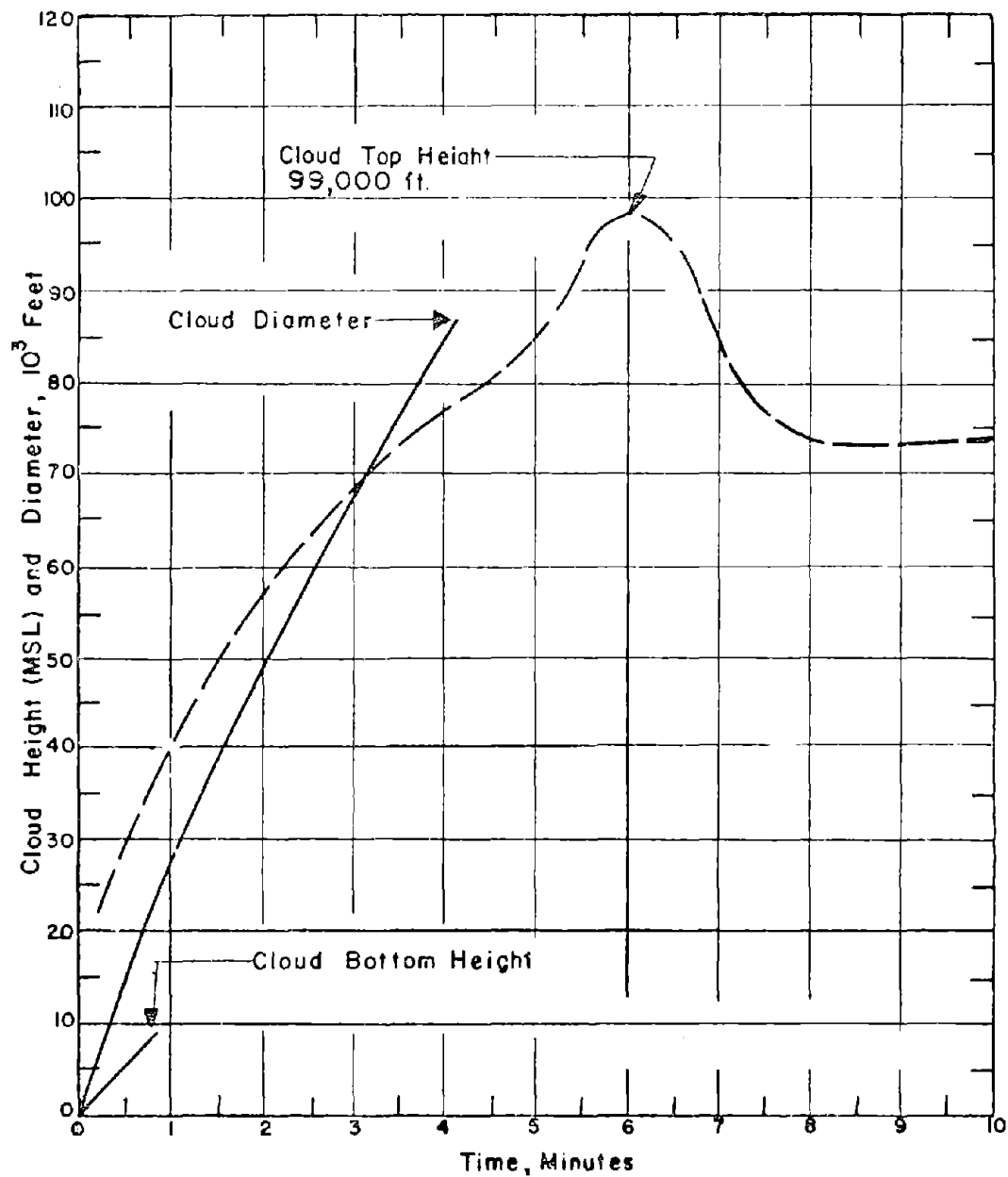


Figure 109. Cloud Dimensions: Operation REDWING - Tewa.

TABLE 33 WIKINI WIND DATA FOR OPERATION REDWING -

TEWA

Altitude (MSL) feet	H-hour		H+3 hours		H+7 hours		H+9 hours	
	Dir degrees	Speed mph	Dir degrees	Speed mph	Dir degrees	Speed mph	Dir degrees	Speed mph
Surface	090	15	090	16	100	15	080	22
1,000	080	17	090	16	100	16	080	13
2,000	090	17	100	17	090	17	090	16
3,000	110	18	100	20	100	24	090	14
4,000	110	18	100	21	100	24	090	18
5,000	110	18	100	20	090	22	100	23
6,000	100	20	110	20	090	22	100	23
7,000	100	22	110	23	090	20	100	22
8,000	090	23	100	24	100	18	090	21
9,000	090	21	110	22	090	21	090	15
10,000	070	20	100	17	090	18	090	15
12,000	080	17	100	15	090	16	080	13
14,000	080	16	100	10	080	10	060	09
15,000	(100)	(12)	(100)	(13)	(090)	(11)	(080)	(12)
16,000	120	07	100	15	090	13	090	14
18,000	090	13	110	15	120	13	160	03
20,000	130	13	120	13	140	12	180	07
25,000	290	09	130	07	180	06	220	15
30,000	320	06	210	13	170	05	260	07
35,000	190	09	260	13	150	05	270	14
40,000	260	23	270	28	270	20	320	18
45,000	250	37	290	21	340	13	040	31
50,000	270	25	260	21	080	20	310	12
55,000	110	06	070	05	080	16	100	17
60,000	070	33	080	37	080	21	090	28
65,000	090	52	100	50	100	54	100	44
70,000	090	48	110	40	090	55	090	40
72,000	---	--	110	37	---	--	---	--
75,000	080	61	---	--	090	60	090	63
80,000	100	55	---	--	090	67	090	69
85,000	100	56	---	--	090	78	---	--
90,000	---	--	---	--	090	108	---	--

## NOTES:

1. Numbers in parentheses are estimated values.
2. Wind data was obtained on board the U. S. S. Curtiss.
3. Tropopause height was 52,000 ft MSL.
4. At H-hour the sea level pressure was 1009.3 mb, the temperature 82°F, the dew point 77°F and the relative humidity 85%.



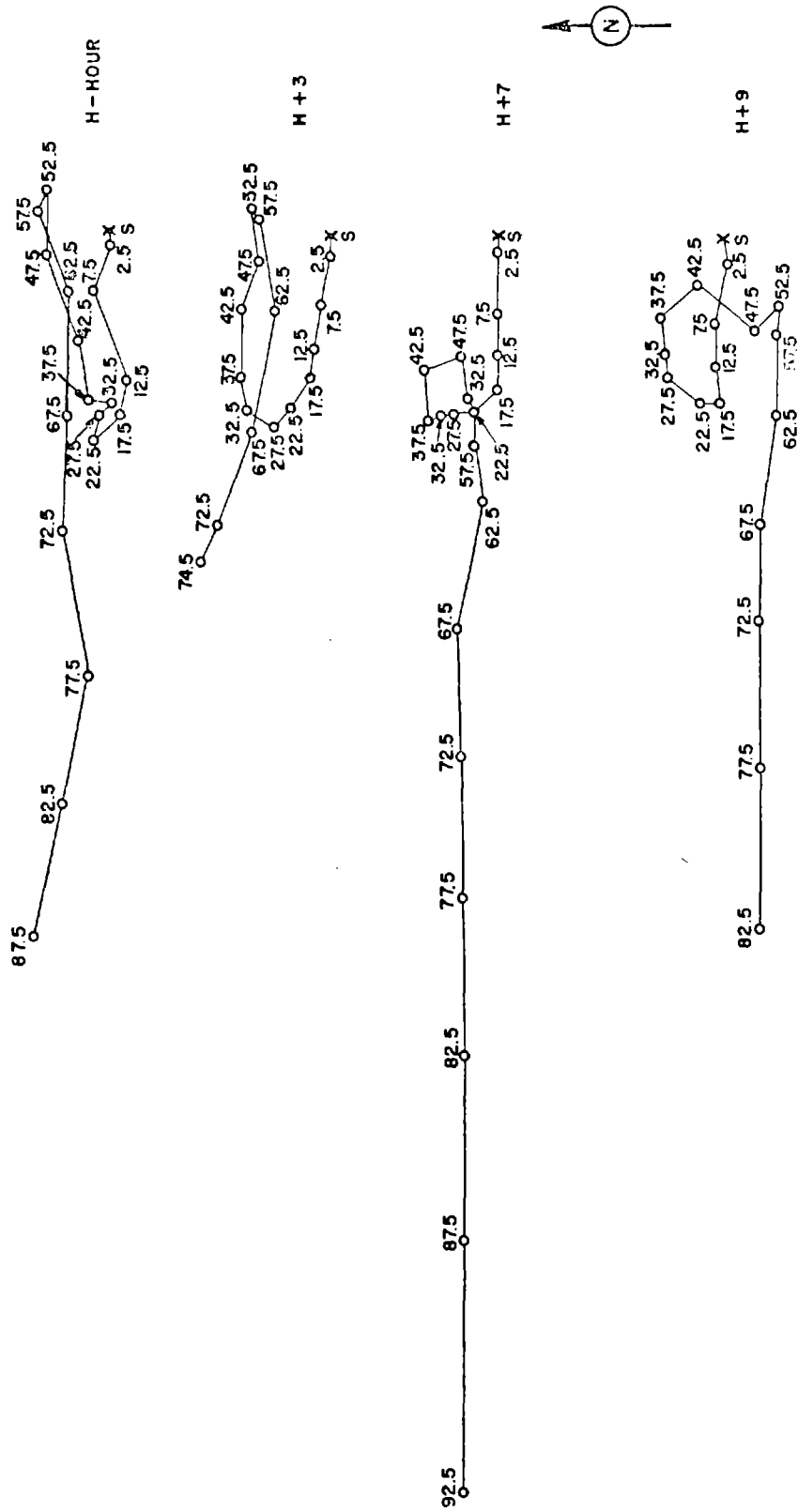


Figure 110. Hodographs for Operation REDWING - Tewa.

OPERATION HARDTACK I -

Wahoo

	<u>PPG Time</u>	<u>GMT</u>
<u>DATE:</u>	16 May 1958	16 May 1958
<u>TIME:</u>	1330	0130

Sponsor: LASL/DOD

SITE: PPG - Eniwetok -south by  
SSW of Irwin about 8,000  
ft from the island  
11° 20' 41" N  
162° 10' 44" E

Site elevation: Sea level

HEIGHT OF BURST: -500 ft under  
water

TYPE OF BURST AND PLACEMENT:

Underwater - Device suspended  
by a cable. Water depth  
3,200 ft

PLUME TOP HEIGHT: 1,760 ft MSL  
at 15½ sec

PLUME DIAMETER: 3,400 ft MSL  
at 15½ sec

REMARKS:

"Nearly all of the total gamma dose occurred within 25 minutes after zero time and was due to the passage of airborne radioactive material. Gamma doses in excess of 100r occurred within the first 15 minutes at downwind distances less than 16,000 feet. In both instances the residual field due to deposited radioactive material was relatively insignificant, although radioactive foam may represent a radiological hazard."

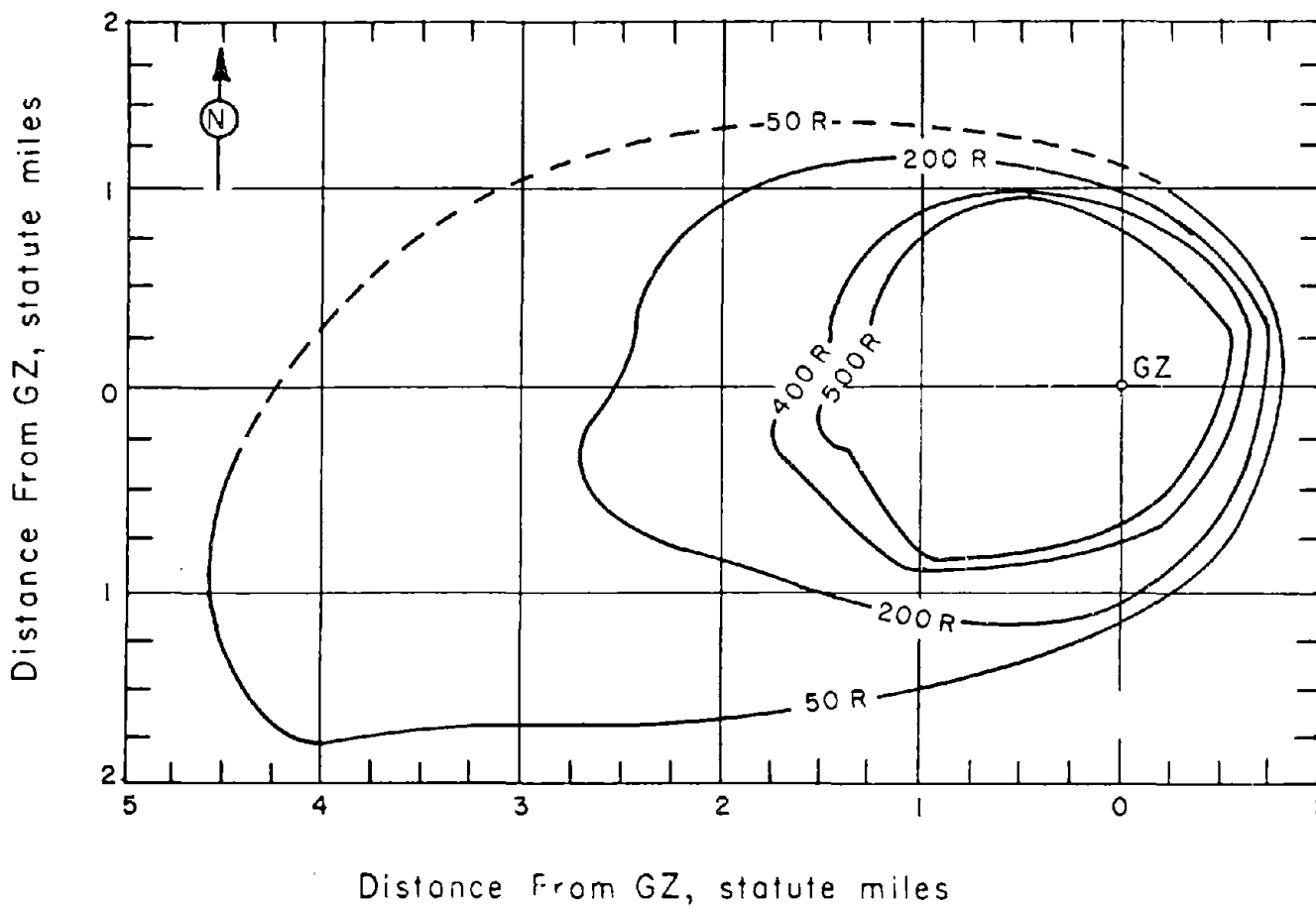


Figure 125. Operation HARDTACK I - Wahoo.  
On-site cumulative dose to 6 hours in roentgens.

TABLE 40 ENIWETOK WIND DATA FOR OPERATION HARDIACK I -

WAHOO

Altitude (MSL) feet	H-1 $\frac{1}{2}$ hours		H+4 $\frac{1}{4}$ hours	
	Dir degrees	Speed mph	Dir degrees	Speed mph
Surface	090	17	080	16
1,000	090	22	080	18
2,000	090	22	080	20
3,000	090	20	080	21
4,000	090	17	080	20
5,000	070	13	060	14
6,000	040	08	050	12
7,000	330	07	350	07
8,000	280	12	300	14
9,000	290	17	300	20
10,000	280	21	300	22
12,000	310	16	290	14
14,000	290	09	310	12
16,000	020	07	340	09
18,000	240	14	020	09
20,000	040	08	040	13
23,000	060	05	010	07
25,000	240	02	360	07
30,000	300	15	260	10
35,000	260	35	---	--
40,000	270	25	270	30
45,000	280	29	---	--
50,000	340	15	310	24
52,000	---	--	270	09
55,000	070	06	---	--
60,000	060	15	020	20
65,000	090	17	---	--
69,000	---	--	120	10
70,000	090	12	100	07
73,000	090	57	060	13
75,000	---	--	---	--
80,000	100	60	090	40
85,000	090	57	---	--
90,000	090	57	090	72
95,000	---	--	---	--
100,000	---	--	090	79
110,000	---	--	100	93
114,000	---	--	100	100

NOTES:

1. Wind data was taken by the Eniwetok weather station.
2. Tropopause height was 59,000 ft MSL.
3. The surface air pressure was 14.69 psi, the temperature 30.8°C, the dew point 73°F, and the relative humidity 63%.

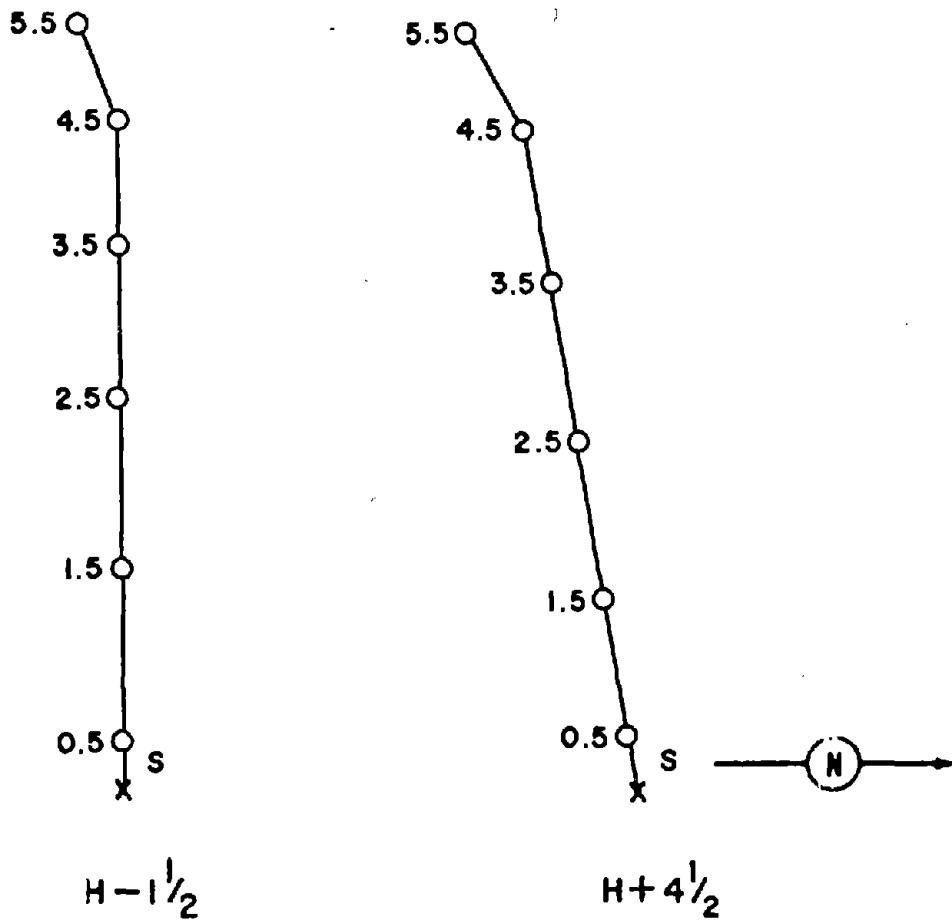
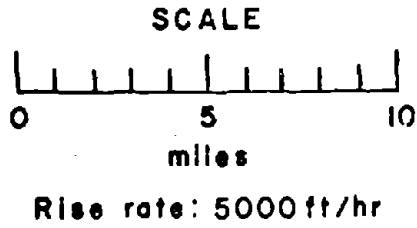


Figure 126. Hodographs for Operation HARDTACK I -

Wahoo

OPERATION HARDTACK I -

Holly

	<u>PPG Time</u>	<u>GMT</u>
<u>DATE:</u>	21 May 1958	20 May 1958
<u>TIME:</u>	0630	1830

Sponsor: LASL

SITE: PPG - Eniwetok - West  
of Yvonne, 4,000 ft  
from the nearest edge  
of the island  
11° 32' 38" N  
162° 21' 22" E

Site elevation: Sea level

HEIGHT OF BURST: 13.06 ft

TYPE OF BURST AND PLACEMENT:

Surface burst from barge on  
water

Water depth: 40 ft

CLOUD TOP HEIGHT: 15,000 ft MSL

CLOUD BOTTOM HEIGHT: 7,000 ft MSL

REMARKS:

Only individual island dose rates are available. These were obtained from helicopter surveys made by the Radiological Safety organization at H+4 hours. The helicopter survey technique called for the pilot either to land the aircraft at the desired spot, so that a ground reading could be obtained, or to make a slow pass over the desired spot at an elevation of 25 feet. Readings taken at 25 feet were multiplied by a factor of 2 in order to obtain a reasonable approximation of the true ground reading. The basic instrument used in the aerial surveys was the AN/PDR-39 survey meter modified to read up to 500 r/hr. The  $t^{-1.2}$  decay approximation was used to extrapolate the H+4 hour dose rate readings to H+1 hour.

OPERATION HARDTACK I

- Umbrella

	<u>PPG Time</u>	<u>GMT</u>
DATE:	9 June 1958	8 June 1958
TIME:	1115	2315

Sponsor: DOD

SITE: PPG - Eniwetok - NNE of  
Henry  
11° 22' 51" N  
162° 13' 09" E  
Site elevation: Sea level  
Water depth: 150 ft

HEIGHT OF BURST: 150 ft underwater

TYPE OF BURST AND PLACEMENT:  
Sub-surface burst on lagoon  
bottom

REMARKS:

The pattern was obtained from a total of about 80 points which is really too few to place much reliance on the rather pronounced lobing of the downwind contours. "Nearly all of the total gamma dose occurred within 25 minutes after zero time and was due to the passage of air-borne radioactive material. Gamma doses in excess of 100r occurred within the first 15 minutes at downwind distances less than 14,000 feet. The residual field due to deposited radioactive material was relatively insignificant, although radioactive foam may represent a radiological hazard."

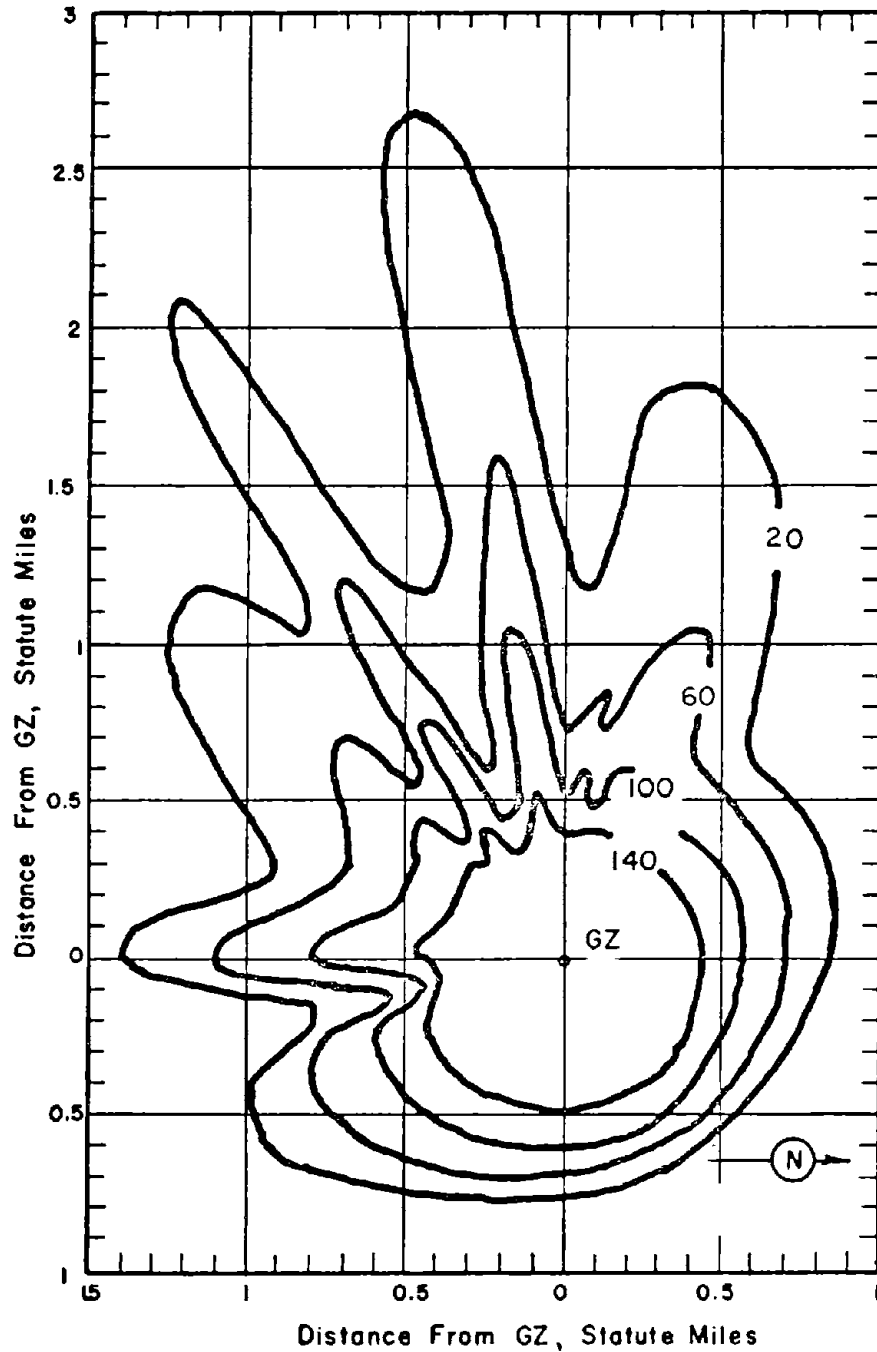


Figure 141. Operation HARDTACK I - Umbrella. Idealized rate contours in r. (Contours represent cumulative dose to 6 hours.)



TABLE 48 ENIWETOK WIND DATA FOR OPERATION HARDTACK I -

UMBRELLA

Altitude (MSL) feet	H+4 <sup>1</sup> / <sub>2</sub> hour		H+6 <sup>1</sup> / <sub>2</sub> hours	
	Dir degrees	Speed mph	Dir degrees	Speed mph
Surface	060	23	070	23
1,000	050	26	---	--
2,000	060	24	---	--
3,000	070	24	---	--
4,000	080	25	---	--
5,000	080	28	---	--
6,000	090	28	---	--
7,000	100	21	---	--
8,000	100	17	---	--
9,000	100	20	---	--
10,000	100	24	---	--
12,000	110	18	---	--
14,000	120	15	070	09
16,000	100	09	060	15
18,000	160	05	080	07
20,000	070	07	190	05
23,000	090	02	030	09
25,000	080	06	360	05
30,000	050	06	350	17
35,000	330	14	250	15
40,000	260	14	270	15
45,000	270	15	200	29
50,000	280	10	200	20
55,000	160	08	150	06
60,000	140	07	040	08
65,000	090	24	120	22
70,000	100	20	080	16
75,000	100	45	---	--
80,000	100	57	090	57
85,000	090	57	---	--
90,000	090	62	090	63
95,000	090	63	---	--
99,000	---	--	090	56
100,000	090	60	---	--
105,000	090	58	---	--

**NOTES:**

1. Wind data was taken by the Eniwetok weather station.
2. Tropopause height was 54,000 ft MSL.
3. The surface air pressure was 14.66 psi, the temperature 30°C, the dew point 72°F, and the relative humidity 63%.

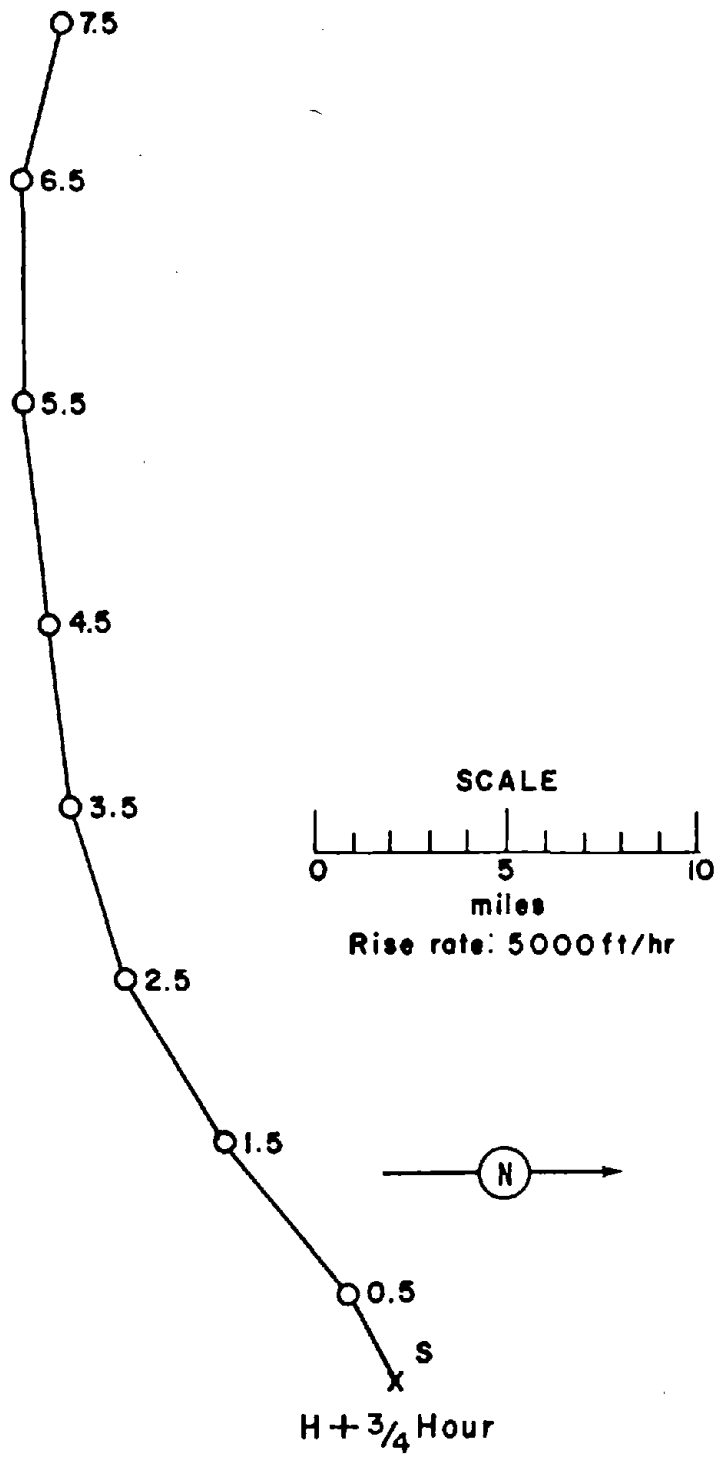


Figure 142. Hodograph for Operation HARDTACK I -

Umbrella.

OPERATION HARDTACK I -

Quince

	<u>PPG Time</u>	<u>GMT</u>
<u>DATE:</u>	6 Aug 1958	6 Aug 1958
<u>TIME:</u>	1415	0215

Sponsor: UCRL - DOD

SITE: PPG - Eniwetok - Yvonne  
11° 33' 15" N  
162° 21' 24" E  
Site elevation: Sea level

HEIGHT OF BURST: 3 ft

TYPE OF BURST AND PLACEMENT:  
Surface burst from platform  
on coral soil

CLOUD TOP HEIGHT: 1,500 ft MSL  
CLOUD BOTTOM HEIGHT: NM

REMARKS:

Only alpha contamination resulted from this detonation. Surface alpha monitoring was conducted throughout the area on D and D+1 day with PAC-3G gas-flow proportional alpha counters. The readings were taken in counts per minute, corrected for the probe area, and multiplied by the appropriate shielding factors to compensate for the roughness of the surface monitored. The two isoconcentration lines shown are the most significant ones, since  $3,500 \mu\text{g}/\text{m}^2$  is the chronic hazard limit and any concentration in excess of  $1,000 \mu\text{g}/\text{m}^2$  requires decontamination. It is interesting to note that in the great majority of cases the alpha concentrations in the downwind area were higher on D+1 than on D day.

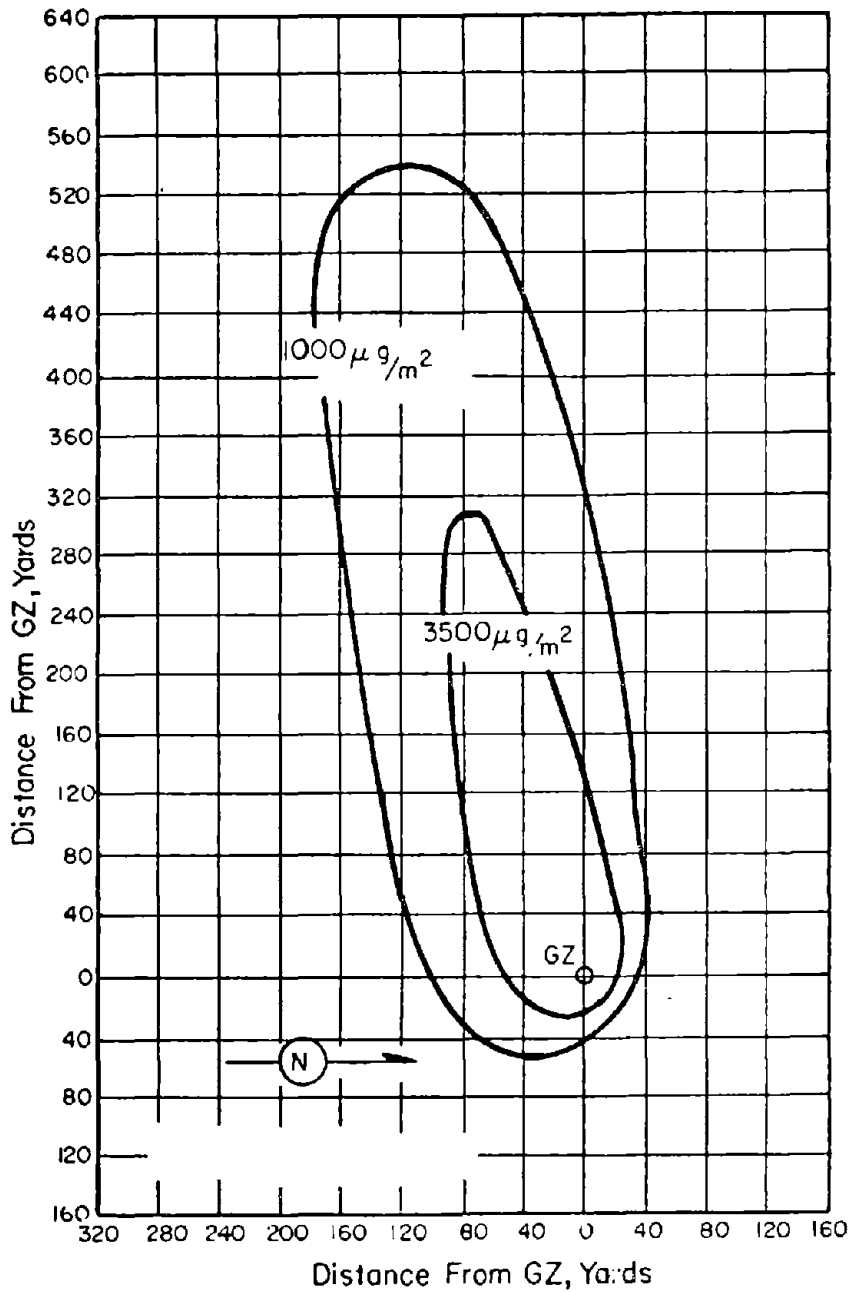


Figure 175. Operation HARDTACK I - Quince.  
Alpha contamination in micrograms per square meter.

TABLE 65 ENIWETOK WIND DATA FOR OPERATION HARDTACK I -

QUINCE

Altitude (MSL) feet	H-hour	
	Dir degrees	Speed mph
Surface	060	13
241	070	14
482	070	14
723	070	16
964	080	16

NOTE: Wind data was taken by the Eniwetok weather station.

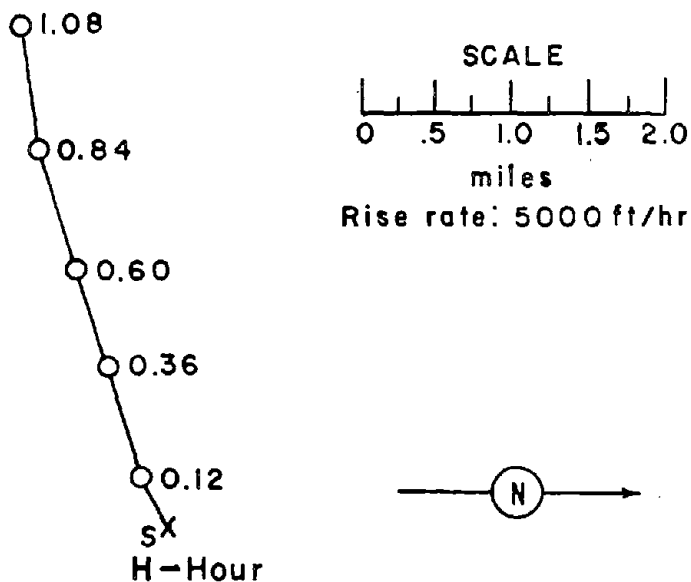


Figure 176. Hodograph for Operation HARDTACK I -

Quince.

OPERATION HARDTACK I -

Fig

	<u>PPG Time</u>	<u>GMT</u>
<u>DATE:</u>	18 Aug 1958	18 Aug 1958
<u>TIME:</u>	1600	0400

Sponsor: UCRL - DOD

SITE: PPG - Eniwetok -  
Yvonne  
11° 33' 15" N  
162° 21' 24" E

Site elevation: Sea level

HEIGHT OF BURST: 1.5 ft

TYPE OF BURST AND PLACEMENT:

Surface burst from platform  
over Nevada soil

CLOUD TOP HEIGHT: 5,400 ft MSL

CLOUD BOTTOM HEIGHT: 4,300 ft MSL

REMARKS:

The dose-rate contours were obtained by ground survey readings made by scientific projects. Actual decay measurements were used to correct the dose-rate readings to H+1 hour. The portion of the pattern on the island is reliable. That portion which is over water is less reliable because it was not based upon free-field dose-rate readings but upon calculations made from readings taken on five barges and from samples collected in sticky pans mounted on 87 buoys.

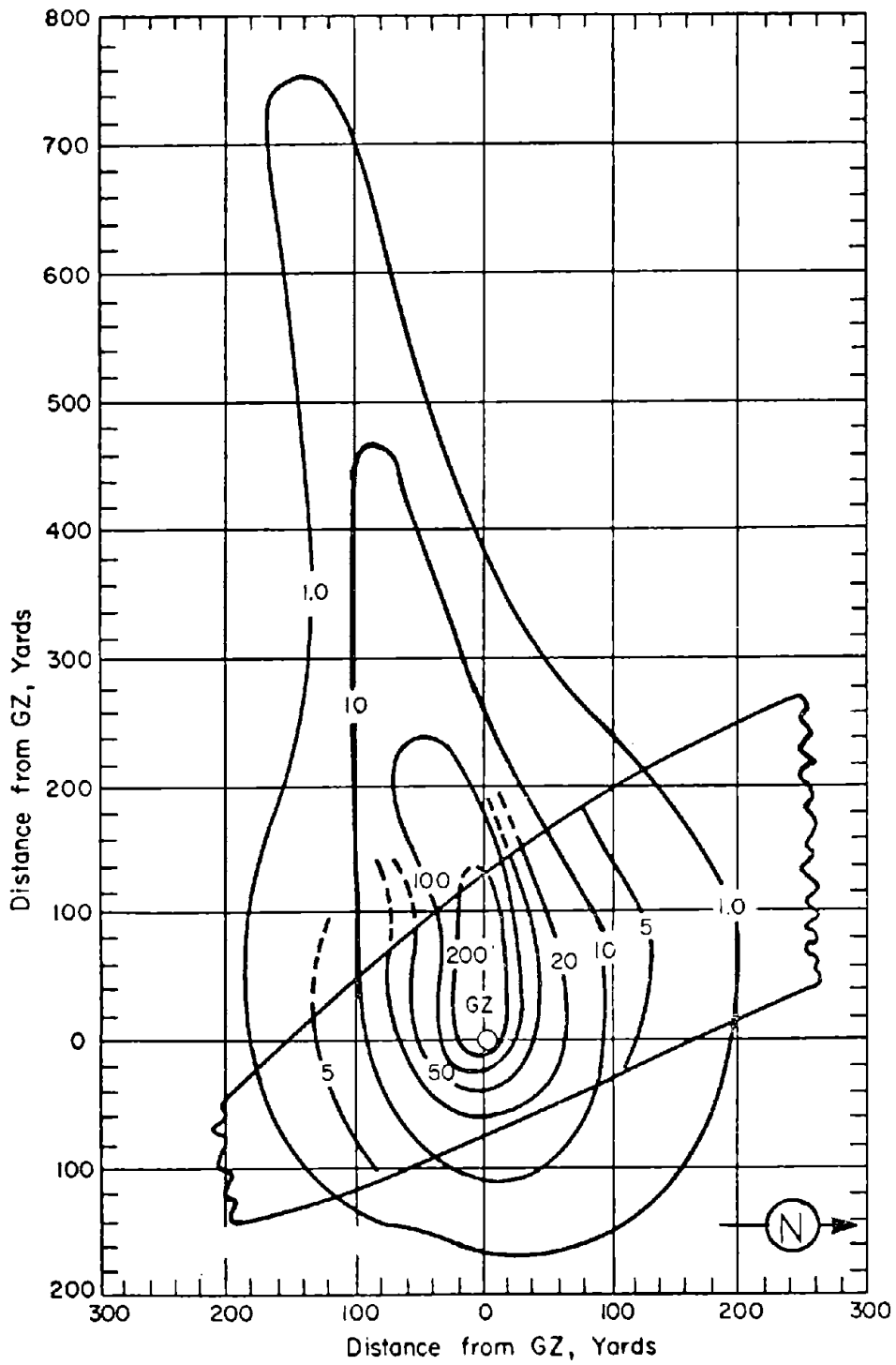


Figure 177. Operation HARDTACK I - Fig.  
On-site dose rate contours in r/hr at H+1 hour.

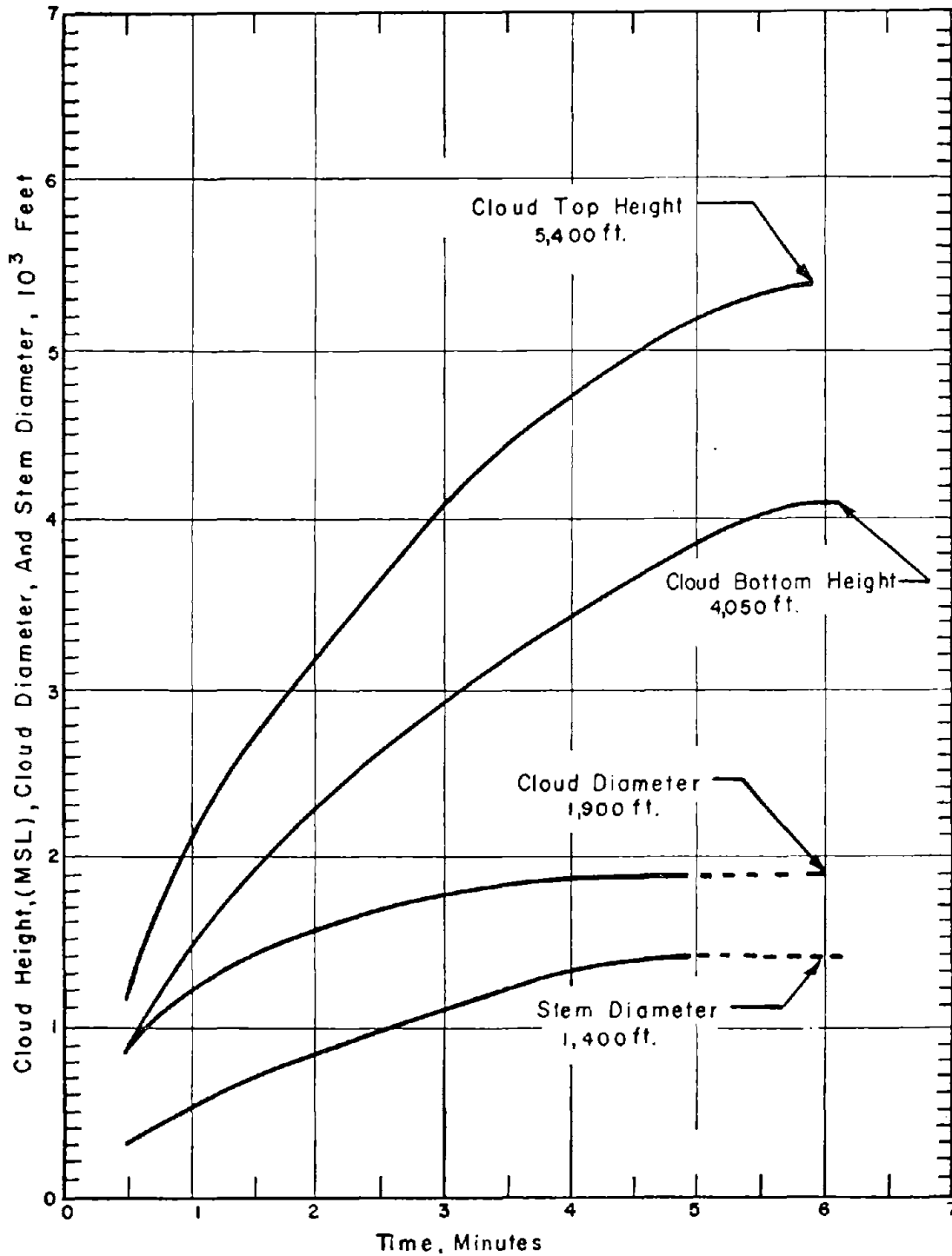


Figure 178 . Cloud Dimensions: Operation HARDTACK I -

Fig.



TABLE 66 ENIWETOK WIND DATA FOR OPERATION HARDTACK I -

FIG

Altitude Range (MSL) feet	H-hour	
	Dir degrees	Speed mph
0 - 1,000	080	17
1,000 - 2,000	090	19
2,000 - 3,000	100	18
3,000 - 4,000	110	19
4,000 - 5,000	100	18
5,000 - 6,000	100	18
6,000 - 7,000	090	18
7,000 - 8,000	090	21
8,000 - 9,000	090	21
9,000 -10,000	080	21

- NOTES: 1. Wind data was obtained by the weather stations on Yvonne Island (Eniwetok Atoll); which were located 1,000 yds and 1,500 yds from GZ.
2. The surface air pressure was 14.62 psi, the temperature 30°C, the dew point 78°F, and the relative humidity 77%.

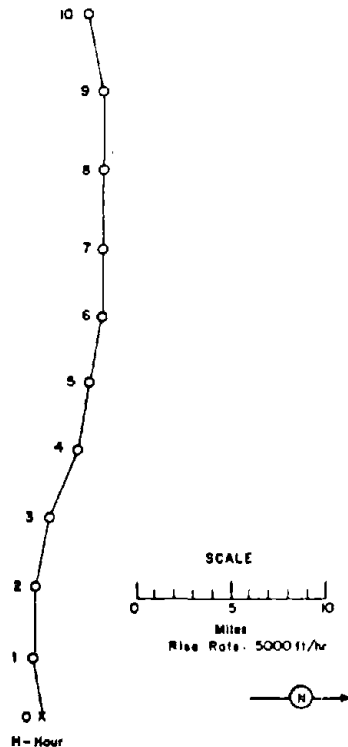


Figure 179. Hodograph for Operation HARDTACK I -

Fig.

OPERATION DOMINIC - Mesilla

DATE: LOCT GMT  
9 May 1962 9 May 1962  
TIME: 0701 1701

SPONSOR: LASL  
SITE: Christmas Island, GZ-10  
SITE ELEVATION: Sea Level  
HEIGHT OF BURST:  
TYPE OF BURST AND PLACEMENT:  
Air (free fall), over  
Pacific Ocean

OPERATION DOMINIC - Muskegon

DATE: LOCT GMT  
11 May 1962 11 May 1962  
TIME: 0537 1537

SPONSOR: LRL  
SITE: Christmas Island, GZ-10  
SITE ELEVATION: Sea Level  
HEIGHT OF BURST:  
TYPE OF BURST AND PLACEMENT:  
Air (parachute drop), over  
Pacific Ocean

OPERATION DOMINIC - Sword  
Fish

DATE: PST GMT  
11 May 1962 11 May 1962  
TIME: 1202 2002

SPONSOR: DOD  
SITE: ~400 miles west of San Diego  
31° 14.7' ± 0.3' N  
124° 13.3' ± 0.3' W  
SITE ELEVATION: Sea Level  
DEPTH OF BURST:  
WATER DEPTH: 17,100 ft  
TYPE OF BURST AND PLACEMENT:  
Underwater, from anti-  
submarine rocket

REMARKS:

Figure 180 illustrates the growth and movement of the pool of radio-activity resulting from the Sword Fish test. The contours from D-day to D+6 days represent readings in mR/hr at 500 feet above the water surface.

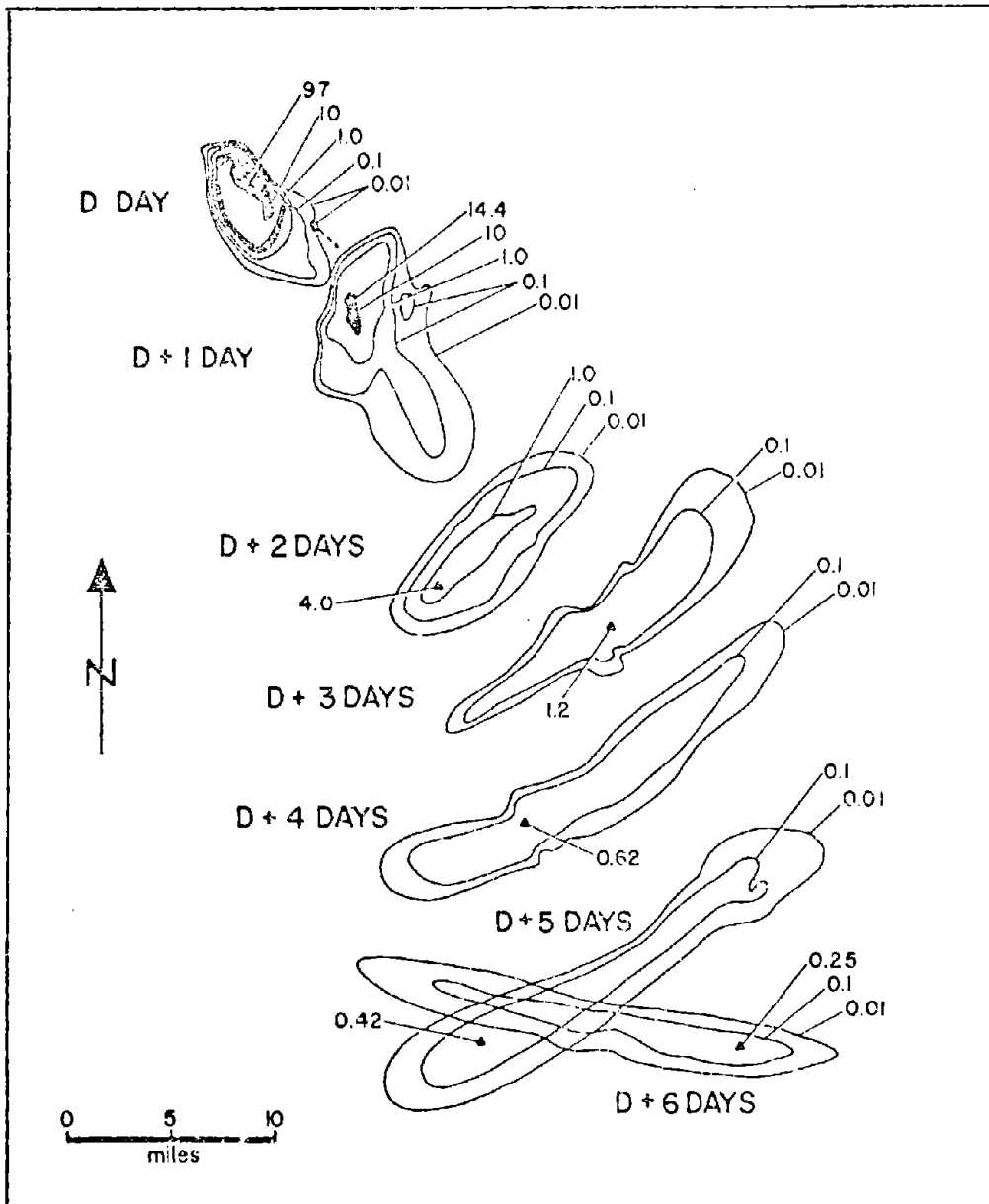


Figure 180. OPERATION DOMINIC - Sword Fish contours showing growth and movement of the pool of radio-activity from D-day to D+6 days. Contours values in mR/hr at the survey aircraft height of 500 feet